AMERICAN
GAS JOURNAL

MAY, 1937

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No. 16A

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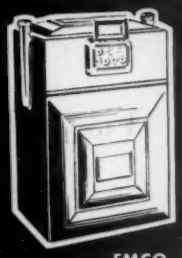
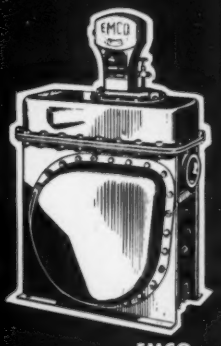


EMCO Tin Meter

EMCO Large Capacity Meter

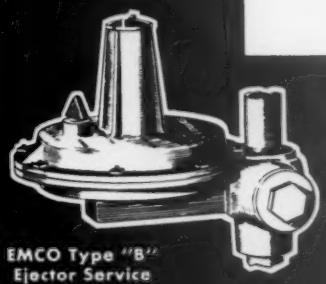


EMCO Large Capacity Pressed Steel Meter with Emcorector

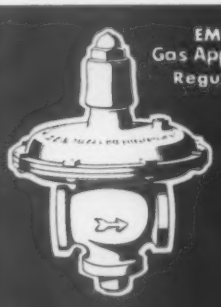
The late George Westinghouse, founder of the company that is now Pittsburgh Equitable, established a precedent when he proceeded to develop more efficient measuring and regulating devices for Natural Gas. He combined research and sound engineering principles with his masterful inventive ability. That precedent has been followed throughout the progress of the company, which has been coincidental with the growth of Natural Gas, and is the Pittsburgh Equitable Idea.

The Pittsburgh Equitable Idea is to bring every aid of modern science into the design and manufacture of gas meters, regulators and allied appliances, so that customers may be provided with the best possible value. To accomplish this end, complete chemical and physical laboratories of our own have been established and are under the direction of competent chemists and research engineers. They are neither hampered by tradition nor cramped facilities. These laboratories also serve as a proving ground to determine the value of all raw materials purchased.

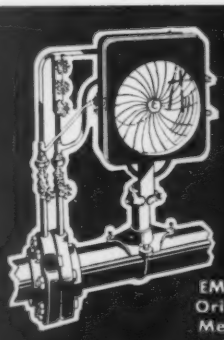
The Pittsburgh Equitable factories are models of their kind. The latest types of machinery—much of it automatic and of special design—assure accurate machining and uniform performance of EMCO products. Workmen are skilled craftsmen, many of whom have spent years with the company. It is the combination of these facilities that has given the name EMCO its high standard and wide, lasting acceptance in Natural Gas.



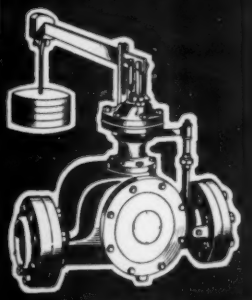
EMCO Type "B" Ejector Service Regulator



EMCO Gas Appliance Regulator



EMCO Orifice Meter



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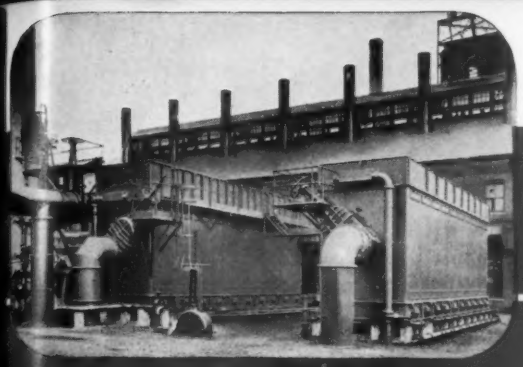
"Western" Equipment makes more and better gas with less fuel and labor— Continuous operation well above 23 hours per day, with increased capacity and lowered costs for fuel and labor, is possible for a water gas set equipped with a "Western" ABC Self-Clinkering Generator Grate (shown above). These grates can be furnished with cone bottom for elevated generators, or flat bottom for setting directly on a foundation.

The "Western" Self-Locking Dump Door (shown below) is standard equipment on these grates, though it can be installed on any cone bottom generator. Operation of this door can be controlled hydraulically from any point, thus protecting the operator from dust and sudden flow of material when the door is opened to dump ashes.

The photographs show installations of "Western" equipment on a 11'0" cone bottom generator at the Citizens Gas and Coke Utility plant, Indianapolis. This new plant recently was delivered to its owners by the Engineering and Construction Division of Koppers.

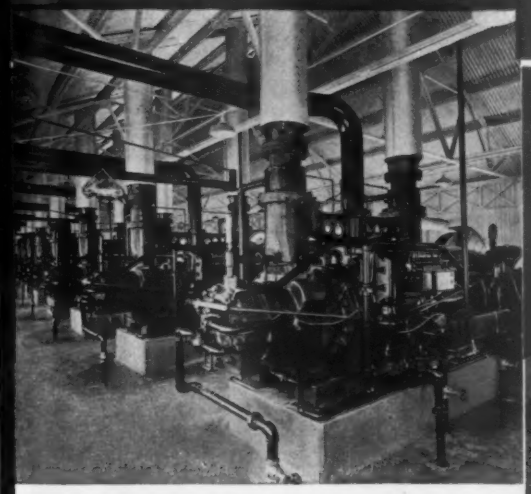
KOPPERS COMPANY • DESIGNERS • BUILDERS • PRODUCERS • MANUFACTURERS



Cast Iron Condensers for Seaboard Plants are a Bartlett Hayward specialty—Wherever salt water must be used for cooling, the corrosion-resisting qualities of cast iron condenser tubes and parts made by Bartlett Hayward Division of Koppers is appreciated. Photo shows a 10-section Cast Iron Condenser built by Bartlett Hayward to handle 12,500,000 cu. ft. of gas per day at the Everett (Mass.) station of the Boston Consolidated Gas Co.

KOPPERS

serves the gas industry



American Hammered Piston Rings help keep these compressors in service every day—Completely equipped with American Hammered Piston Rings, the eight, 200 horsepower compressors pictured here are used by a Texas oil refining company to handle more than 1,800,000 cubic feet of gas every day. The American Hammered Piston Ring Division of Koppers, at Baltimore, Md., produces hammered piston rings exclusively for every industrial use.

Coals supplied by Koppers come only from fields of known high quality—One of the country's most important producers, The Koppers Coal Company operates 25 mines with a total annual capacity of more than 12,000,000 tons. Each of these mines is located in a field known for high quality; and every ton produced must meet the rigid Koppers inspection, backed by daily tests in the Koppers Coal Laboratories. The result is a product of uniform excellence—coals which may be depended upon for efficient, economical performance.

A Koppers Roof is the best protection for any flat deck structure—The Koppers roof, as the photograph shows, is built up of alternate layers of Tarred Felt and moppings of Coal Tar Pitch. Such a roof endures prolonged contact with water and makes replacement a matter of twenty or more years.

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- ☐ Coke Oven Plants
- ☐ Water Gas Sets
- ☐ Heavy Oil Water Gas Processes
- ☐ Other Gas Manufacturing Plants
- ☐ Scrubbers
- ☐ Conveying Systems
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- ☐ Treated Lumber
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- ☐ Fire Hydrants
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- ☐ Motor Fuel Recovery Plants
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- ☐ Bituminous Paints
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- ☐ Pipe
- ☐ American Hammered Piston Rings
- ☐ Coal Tar Paving Materials
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Looking down on a mechanical joint ready for assembly, showing various parts.

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Research Engr., 1013 Peoples Gas Bldg., Chicago

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Play safe! Use NATIONAL SEAMLESS Line Pipe to get the ultimate in pipe line reliability — reliability that helps control costs on initial laying operations, upkeep of the line and maintenance.

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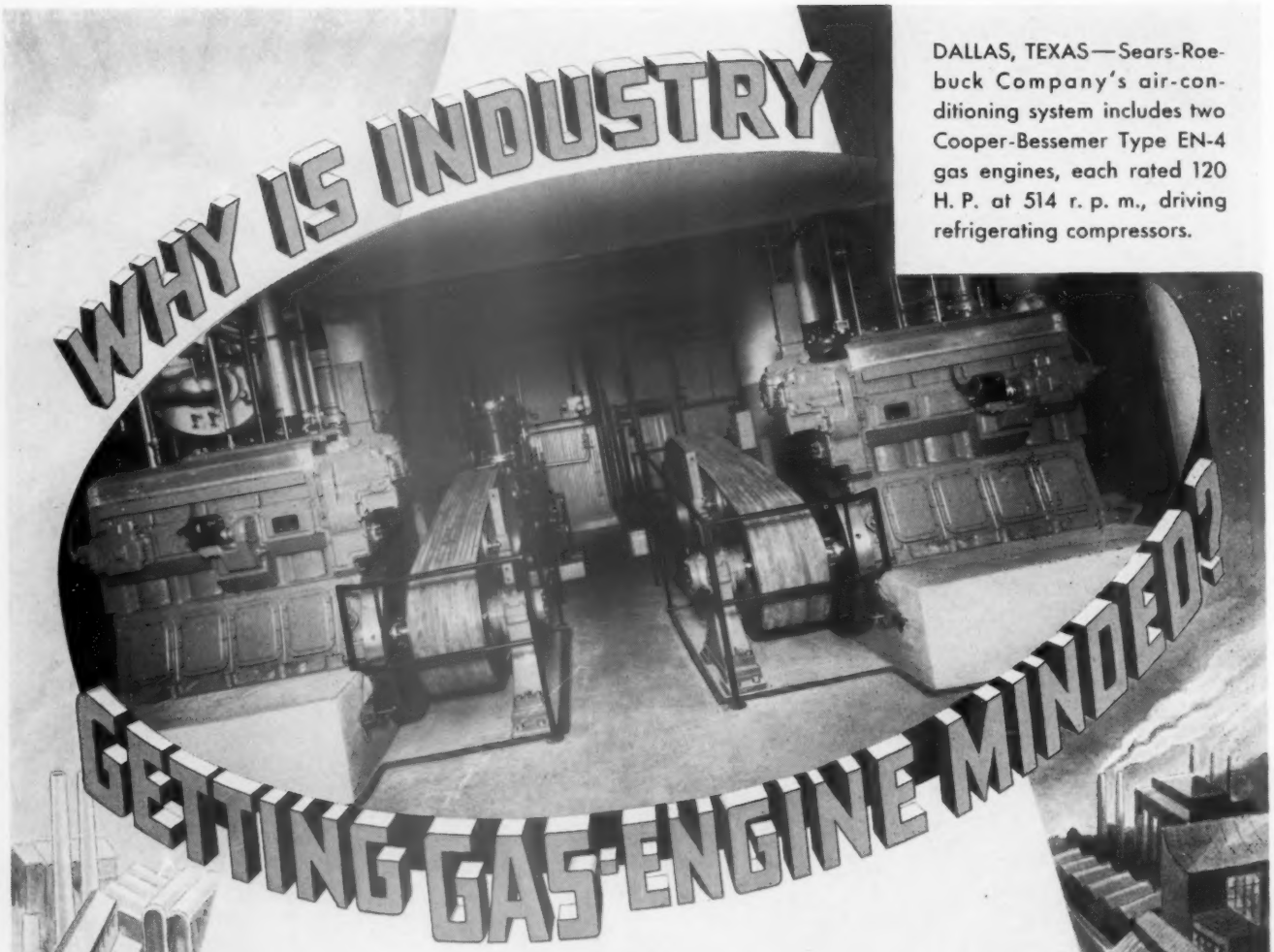
United States Steel Products Company, New York, *Export Distributors*

UNITED STATES STEEL



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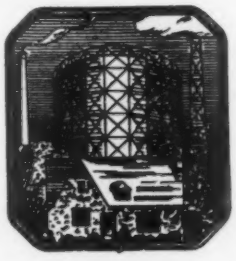

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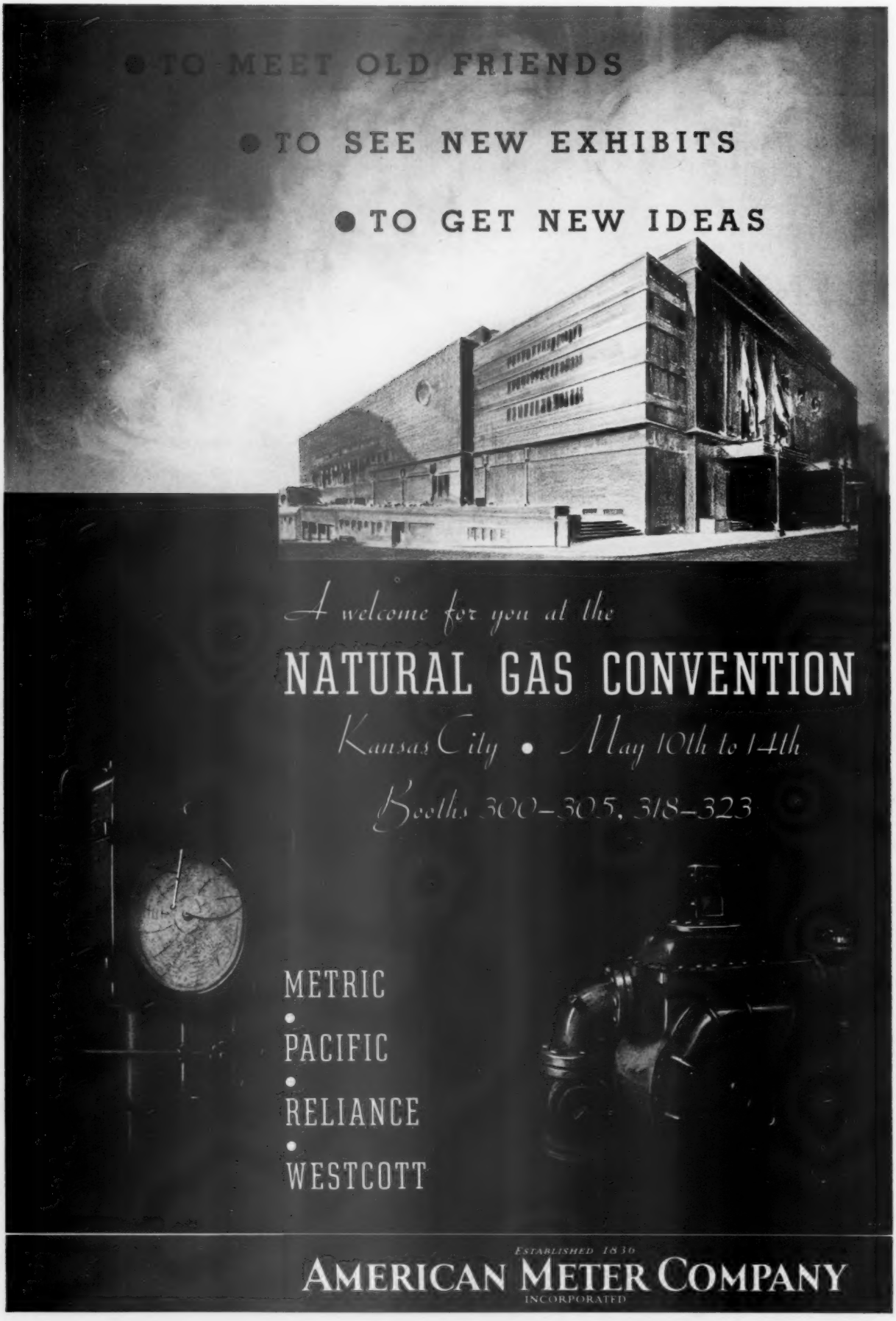
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MAY
1937

AMERICAN
GAS JOURNAL

VOLUME 146
No. 5

Natural Gas In California

By Claude C. Brown

Consulting Chief Engineer
Railroad Commission of the State of California

IT MAY be truly said that natural gas has become the universal fuel in California. While it is a fact that other fuels are still being used in substantial quantities, the availability, dependability, ease of handling, efficiency of utilization, and low price of natural gas has resulted in the general displacement of other fuels by this commodity.

California has always consumed the natural gas that has been produced within its boundaries. None has ever been exported or imported and, with the exception of certain periods of wastage in the past, the total production of this valuable commodity has been put to good and beneficial use by the domestic, commercial and industrial gas users of this Commonwealth. During the year 1936, a total of 351 billion cubic feet was produced from California fields, of which 153 billion cubic feet was used by these three classes of gas utility customers.

Domestic Residential Use

Natural gas has brought many distinct benefits to the people of California. To the domestic customer it has afforded an economical, clean, dependable, efficient, and ever-ready source of heat for all purposes. It heats his home, cooks his meals, heats his water, and runs his refrigerator. It does all of these things either automatically or at the opening of a valve. It has relieved him of the burdens of piling, hauling, storing and kindling of fuels, and the disposal of ashes and soot. And it has substantially reduced his fuel bills.

CLAUDE C. BROWN

During the year 1936, the domestic customers of California used a total of 57 billion cubic feet of natural gas.

It is interesting to compare the present cost of natural gas to a domestic customer in San Francisco with the cost to him of an equivalent quantity of heat in manufactured oil gas in the year 1929, just prior to the introduction of natural gas.

The natural product now being served in San Francisco has a heating value averaging 1195 British thermal units per cubic foot on the dry basis. The domestic customer's monthly bill for 4000 cubic feet of this gas under present rates is $3.43. In 1929, for an equivalent heat quantity of 550 B.t.u. manufactured oil gas at the then prevailing rates, the monthly bill was $7.83. This represents a reduction of over 56%.

Commercial Use

To the commercial customer it has brought the same benefits. Its wide and increasing use in hotels, apartment houses, stores, and other commercial establishments proves its value as a fuel to these types of users. The uniform conditions of quality and pressure under which it is delivered guarantee uniform heating when standard appliances are used and properly maintained.

During the year 1936, a total of fourteen billion cubic feet of natural gas was used in California by commercial customers. Here, again, the introduction of natural gas has resulted in reduced fuel bills. The monthly gas bill for an apartment house in San Francisco, using 100,000 cubic feet of natural gas per month, under present rates is $99.50 as compared to $150.80 for an equivalent amount of heat from manufactured oil gas in 1929.

Industrial Use

Prior to the advent of natural gas in California, very few of the industries in the State used gas for fuel purposes. The reason for this is obvious, as gas made from oil cannot

compete with oil as a fuel. Only those industries to whose processes gas was essential were industrial gas consumers.

However, when natural gas was introduced and became widely available for industrial use at low rates, a great many of these industrial enterprises changed over to gas.

In addition to these, many other types of industry were attracted to California by the cheap fuel and other advantages, many of which industrial enterprises could not operate with other fuels such as wood, coal or oil. These include the many and varied types of ceramic manufacturers, glass manufacturers, brick, tile and pottery plants, special metal processing plants, and many others.

The industrial use of natural gas has grown tremendously in California, and is still increasing. In 1936, a total of 82 billion cubic feet

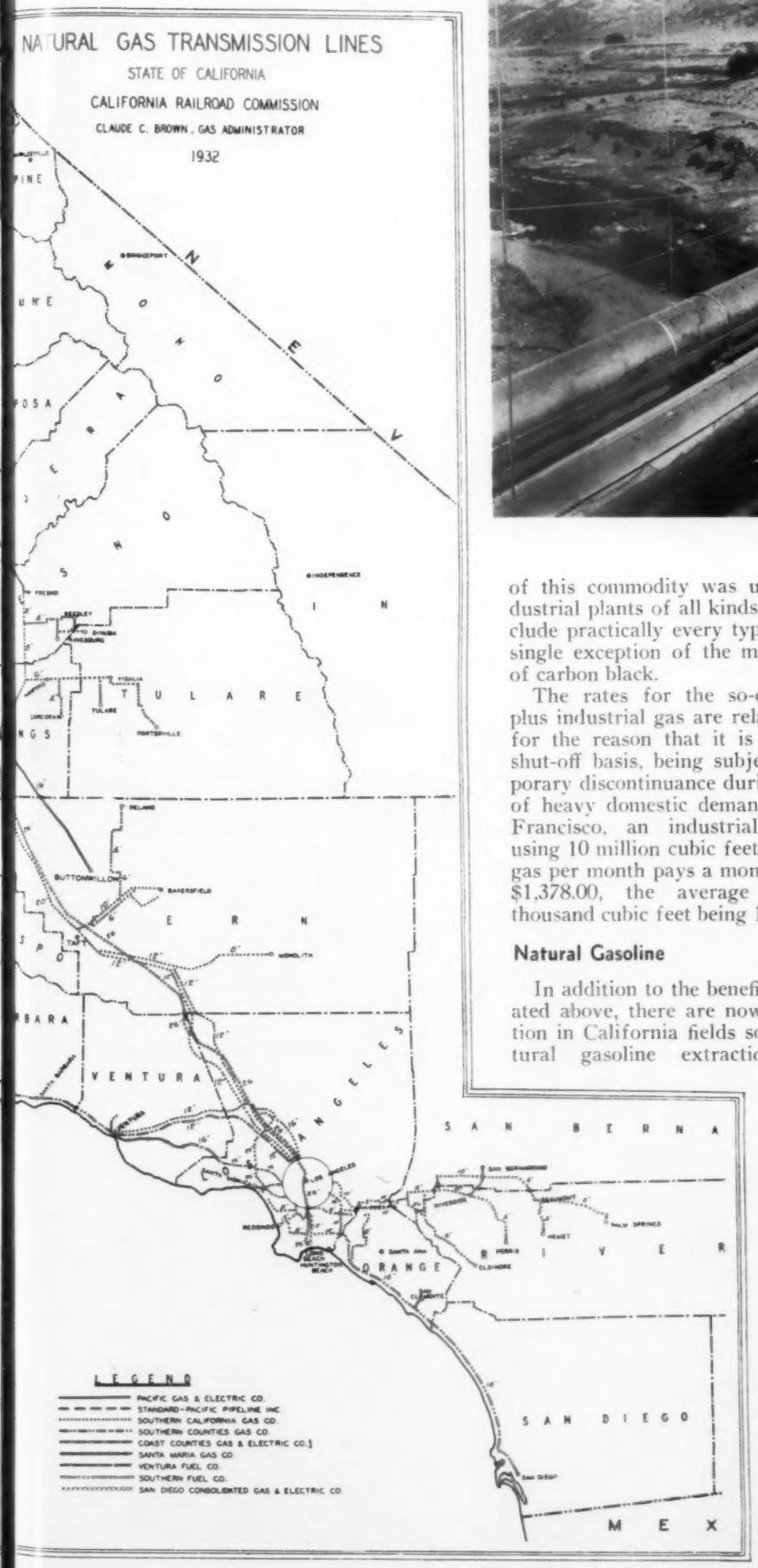
THE PHOTOS

LEFT ABOVE:—NEAR LAGUNA BEACH, ON THE LINE OF THE SOUTHERN COUNTIES GAS CO. WHICH EXTENDS FROM HUNTINGTON BEACH TO SAN DIEGO. PRIMED PIPE READY FOR ENAMELING. PHOTO COURTESY THE BARRETT COMPANY.

BELOW:—SECOND IN PRODUCTION IS THE VENTURA AVE. FIELD IN THE COASTAL AREA. PHOTO © SPENCE AIR PHOTOS.

The Author gives a picture of conditions as they existed in 1936, a glimpse into the future, outlines some of the benefits resulting from the introduction and wide use of Natural Gas in the State, and includes an estimate of the future supply from known sources.

RIGHT:—TWIN LINE CROSSING PANOCHE CREEK. PHOTO COURTESY PACIFIC GAS & ELECTRIC CO.



of this commodity was used in industrial plants of all kinds, which include practically every type with the single exception of the manufacture of carbon black.

The rates for the so-called surplus industrial gas are relatively low for the reason that it is sold on a shut-off basis, being subject to temporary discontinuance during periods of heavy domestic demand. In San Francisco, an industrial customer using 10 million cubic feet of natural gas per month pays a monthly bill of $1,378.00, the average rate per thousand cubic feet being 13.78 cents.

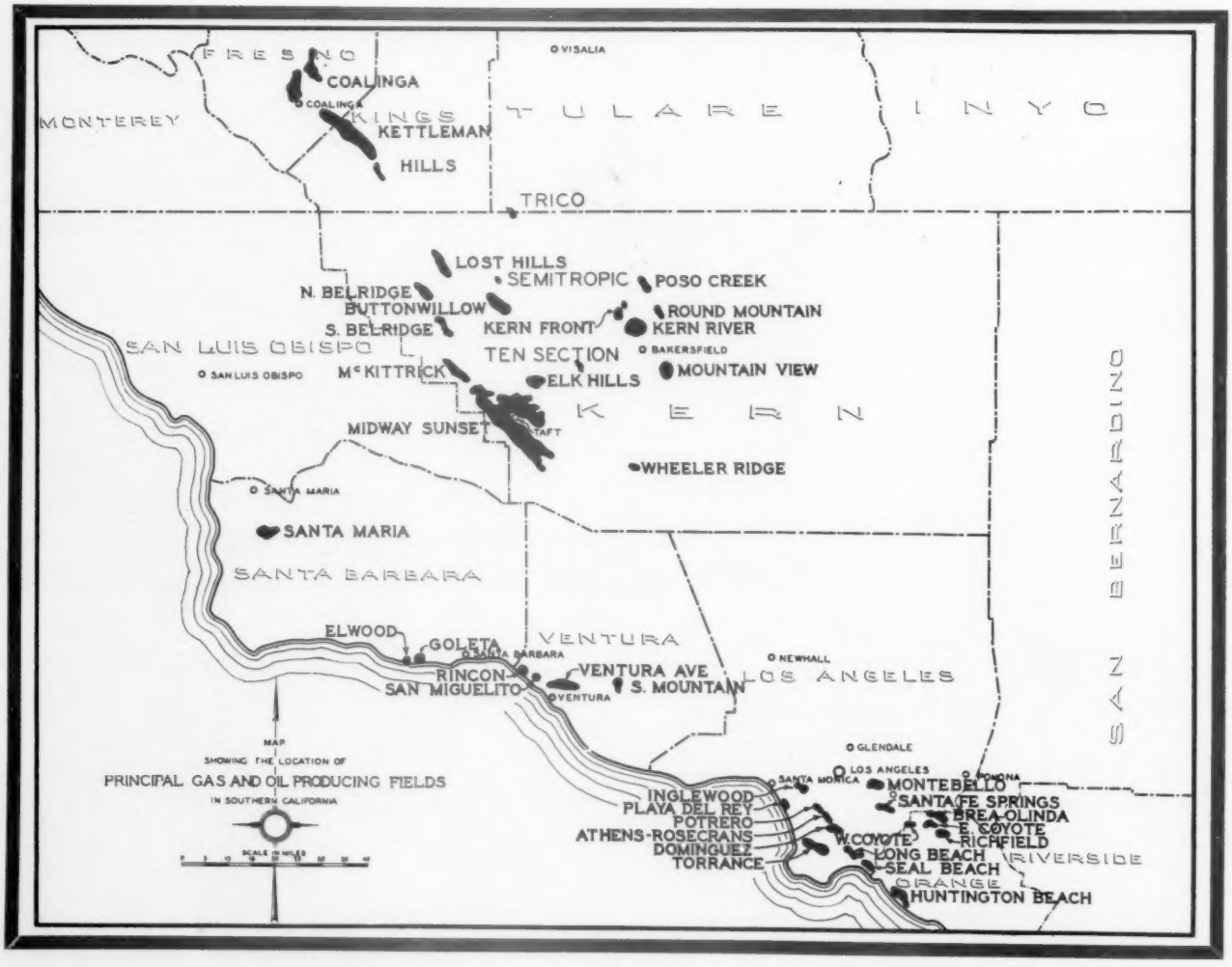
Natural Gasoline

In addition to the benefits enumerated above, there are now in operation in California fields some 90 natural gasoline extraction plants, which extract from the casinghead gas its content of natural gasoline and other condensible hydrocarbons. During the year 1936, the total quantity of natural gasoline so extracted amounted to 603,277,200 gallons. This natural gasoline formed a substantial portion of 1,625,543,316 gallons of commercial gasoline sold in California in 1936.

Production and Utilization of Natural Gas, 1936

The following tabulation sets forth the production and utilization of natural gas in California during the year 1936, all figures being in billions of cubic feet:

I. PRODUCTION		
Total Production from all fields		351
II. UTILIZATION		
(1) Repressuring and Storage	10	
(2) Gasoline Plant Fuel & Shrinkage	52	
(3) Field Fuel	44	
(4) Other Fuel	6	
(5) Sales to Utilities and Others	215	
Sub-total	327	
III. WASTAGE—Blown to the Air	24	
Total	351	351
IV. DETAIL OF II (5) above:		
(1) Sales to Utilities	200	
(2) Sales to Others	15	
Total	215	
V. DETAIL OF IV (1) above:		
(1) Sales to Domestic Customers	57	
(2) Sales to Commercial Customers	14	
(3) Sales to Industrial Customers	82	
(4) Used for Electric Generation	21	
(5) Company Use	11	
(6) Losses	15	
Total	200	
VI. TOTAL NUMBER OF METERS		1,541,000
VII. TOTAL MILES OF MAINS		21,800



Revenues and Expenses of Gas Utilities

The natural gas statistics set forth in V, VI and VII, above, apply to 12 privately-owned and 2 publicly-owned gas distributing utilities. The total gross revenue of these 14 utilities for the year 1936 was as follows:

From sale of gas	$72,500,000.00
Miscellaneous	2,200,000.00
Total	$74,700,000.00

Their total operating expenses were as follows:

Production Expense	$19,400,000.00
Transmission Expense	1,300,000.00
Distribution Expense	6,500,000.00
Commercial Expense	3,800,000.00
New Business Expense	2,300,000.00
General Expense	3,600,000.00
Depreciation Expense	9,600,000.00
Uncollectable Bills	400,000.00
Taxes	8,300,000.00
Total	$55,200,000.00

Present Sources of Natural Gas

The natural gas now being produced in California comes from 39 principal oil and gas fields, 30 of which produce casinghead gas in conjunction with oil and 9 of which produce dry gas alone. Many of these fields have been producing continuously for more than 15 years and some of them for more than 30 years.

The producing areas of the State may be divided into three general geographical groups, as follows:

Group	Number of Fields	P.C. of Total 1936 Production
San Joaquin Valley	17	57%
Coastal Area	8	14%
Los Angeles Basin	14	29%
Totals	39	100%

KETTLEMAN HILLS

THOUSANDS OF FEET BENEATH THIS RUGGED TERRAIN LIES A VAST RESERVOIR OF FUEL WITH 161 PRODUCING WELLS IN 1936. FROM HERE THE ARTERIES OF INDUSTRY AND SERVICE EXTEND NORTH AND SOUTH. PHOTO © SPENCE AIR PHOTOS.

These groups include the following fields:

San Joaquin Valley

Belridge	McDonald Island*
Buena Vista Hills*	Midway-Sunset
Buena Vista Lake*	Mountain View
Buttonwillow*	Rio Vista*
Coalinga	Semi Tropic*
Elk Hills	Tracey*
Kettleman Middle Dome	Trico*
Kettleman North Dome	Ten Section
Lost Hills	

Coastal Area

Capitan	Santa Maria
Elwood	San Miguelito
La Goleta*	South Mountain
Rincon-Padre Canyon	Ventura

Los Angeles Basin

Brea-Olinda	Playa del Rey
Coyote	Potrero
Dominguez	Richfield
Huntington Beach	Rosecrans-Athens
Inglewood	Santa Fe Springs
Long Beach	Seal Beach
Montebello	Torrance

* Dry gas.

The total natural gas production from these fields during 1936 totaled 351 billion cubic feet, 5 billion of which was dry gas and the balance casinghead.

The ten most prolific producers were as follows:

Field	*Annual Production—Billion Cu. Ft.*
Kettleman-North Dome	109
Ventura	39
Beldridge	36
Huntington Beach	21
Long Beach	21
Dominguez	18
Mountain View	16
Midway Sunset	14
Santa Fe Springs	11
Playa del Rey	6

As indicated above, the largest producer was Kettleman Hills North Dome. This is an interesting field, comprising approximately 16,500 acres in an area two miles wide and fifteen miles long. It is located in Kings and Fresno Counties about midway between San Francisco and Los Angeles.

About 1820 acres or 49.7% is operated on the unit plan by Kettleman North Dome Association, 7760 acres, or 47%, is owned in fee and operated by Standard Oil Company of California, and the remaining 540 acres, or 3.3%, is owned and operated by independents. The field has 161 producing wells varying in depth from 7090 to 8000 feet and contains five producing zones varying in thickness from 175 to 425 feet.

The original bottom hole pressure on the wells averaged 2800 lbs. per square inch. In some portions of the field this has been reduced to 1250 lbs.

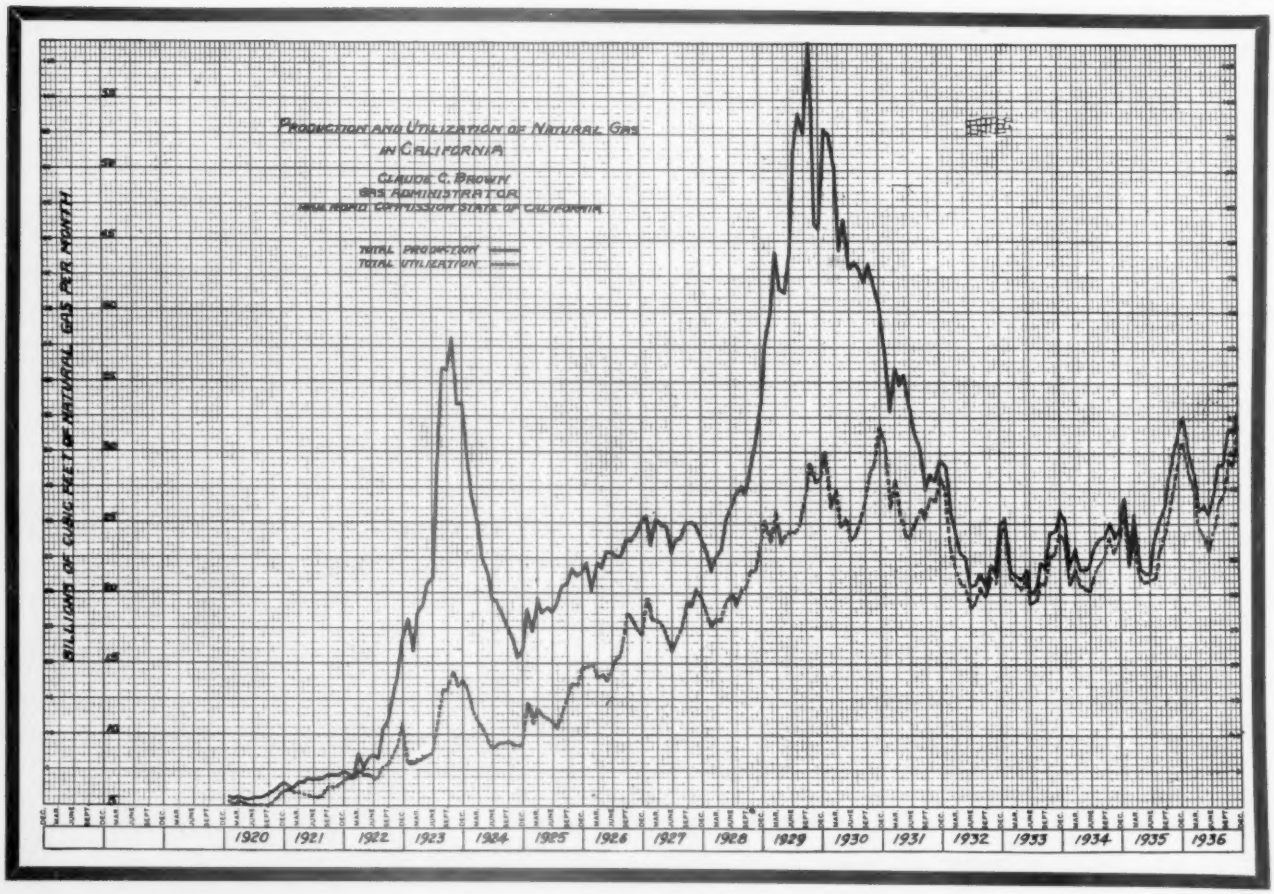
New Gas Producing Areas Developed in 1936

During the last few years there has been a great deal of activity in the search for new oil and gas fields in California. The use of geophysical methods of prospecting have been widely extended, and with considerable success. The first major field to be discovered through this means of location is what is known as the Ten Section field located in Section 29, Township 30 South, Range 26 East, M.D.B. & M. on the floor of the San Joaquin Valley, approximately 14 miles southwest of Bakersfield in Kern County. The discovery well was Shell Oil Co.'s K. C. L. Stevens A-1, which was brought in on June 2, 1936, making 16 million cubic feet of wet gas and 1093 barrels of 61.5 A.P.I. gravity oil per day from a depth of 7900 feet, with a gas pressure of 2300 lbs. on the casing and 1950 lbs. on the tube. During the month of December, 1936, this field produced a total of 418 million cubic feet of wet gas.

Other new fields discovered and proven during the year include Standard Oil Co.'s developments on McDonald and Roberts Islands, in

THE PHOTOS
ABOVE:—APPLYING PRIMER ON THE 8-INCH LINE FROM SANTA MARIA TO PISMO BEACH.
RIGHT: — SETTING PIPE OVER TRENCH AFTER PRIMING. PHOTOS COURTESY THE BARRETT COMPANY.

HUNTINGTON BEACH
HERE A FOREST OF WELL DERRICKS ASSUMES COMMAND OF THE WATER FRONT. IT VIES WITH LONG BEACH IN ANNUAL PRODUCTION. COURTESY SPENCE AIR PHOTOS.



the San Joaquin River, some 10 miles west of Stockton, its Greeley Field north of Ten Section, and its developments in the old Tulare Lake Bed area in Fresno County. Also Amerada Petroleum Corporation's Tracey and Rio Vista fields.

In addition to these new sources of gas, a number of which are dry gas reserves, further extensions of known producing areas were made and deeper producing horizons located. These include extensions of Montebello, Torrance, Huntington Beach, Redondo, El Segundo, Playa del Rey, Richfield and Dominguez fields in the Los Angeles Basin, in Kettleman Hills, Mountain View and Fruitvale fields in the San Joaquin Valley and in Santa Maria, San Miguelito, and Ventura fields in the Coastal area. Deeper producing sands were proved at Torrance, and a number of other fields.

During the year there were a total of 802 new wells completed, 790 producing oil and gas and 12 producing dry gas alone: 772 existing wells were deepened or redrilled, and 449 abandoned.

Probable Future Sources of Natural Gas

In addition to these developments, extensive prospecting and experimental drilling was conducted in all

Natural Gas in California, Year 1936.—M. C. F.

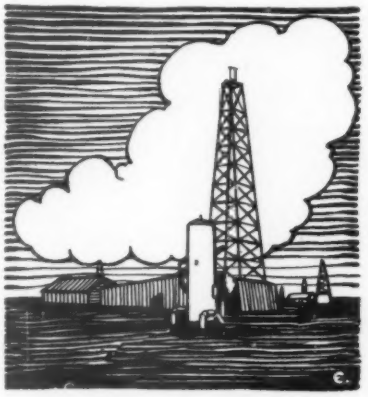
Month	Net Production	Repressuring and Storage	Gasoline Plt. Fuel and Shrinkage	Field Fuel	Other Fuel	Delivered to Gas Utilities	Blown to the Air
January	32,670,400	303,500	4,590,500	3,704,200	957,100	21,131,200	1,983,900
February	29,760,500	745,900	3,975,200	3,759,700	496,800	19,472,300	1,310,600
March	28,593,600	769,300	4,110,800	3,717,500	580,500	18,040,700	1,374,800
April	26,079,800	751,200	3,928,400	3,443,500	434,200	16,208,600	1,313,900
May	26,282,900	733,200	4,279,800	3,398,400	377,800	15,171,100	2,322,600
June	25,704,800	668,100	4,189,700	3,473,200	310,800	14,511,500	2,551,500
July	27,360,000	882,700	4,488,300	3,538,900	549,300	15,232,300	2,868,500
August	29,266,800	895,500	4,569,200	3,506,200	418,300	16,966,800	2,910,800
September	29,247,300	988,700	4,516,600	3,627,500	413,800	17,532,000	2,230,700
October	31,652,400	1,119,800	4,642,100	3,985,400	495,100	19,261,300	2,148,700
November	31,267,400	1,164,400	4,465,200	3,922,900	542,500	19,063,600	2,108,800
December	32,921,800	811,700	4,576,700	3,905,800	740,000	21,982,900	904,100
Total--	350,807,100	9,772,000	52,332,500	43,783,200	6,316,200	214,574,300	24,028,900
% of Total--	100.00%	2.75%	14.92%	12.48%	1.80%	61.20%	6.85%
1935 Figures							
Total	304,867,400	3,892,700	50,032,000	39,310,000	8,804,700	183,453,400	19,374,600
% of Total	100.00%	1.31%	16.40%	12.88%	2.89%	60.17%	6.35%

parts of the State, much of which yielded encouraging showings. This included work in Colusa, Glenn, Tehama, Sutter and Yolo Counties in the North; Merced, Madera, Stanislaus, Fresno and Kern Counties in the San Joaquin Valley, as well as development in the Coastal and Los Angeles Basin areas.

The successful development of geophysical methods of prospecting have greatly enhanced the chances of locating underground structures, the existence of which are in no way indicated by surface geological evidence. It may be confidently expected that the existence of many hitherto unknown reserves will be established in the future by these methods.

Life of the Natural Gas Supply

Estimates of the natural gas resources of California have been made at different times in the past by various authorities on the subject. These have ranged from 18 to 75 trillion cubic feet. Recent estimates of the oil reserves vary from 2.7 to 3.2 billions of barrels of oil.



From the best information available today, it would appear that a reasonable estimate of the recoverable gas remaining in presently known reserves approximates 25 trillion cubic feet.

As hereinbefore set forth, the 1936 annual production from California fields exceeded 350 billion feet. The demand for this commodity is continually increasing and it is probable that an average figure of 500 billion may be reached within the next twenty years.

At the latter average rate of withdrawal, the presently known reserves should last for a period approximating 50 years, which period may very probably be lengthened by the discovery of additional fields.

How a Gas Company Saves Money In Reconditioning Pipe

By A. F. Davis

Vice President,
The Lincoln Electric Company, Cleveland, Ohio

EXPERIENCE gained in the application and use of electric welding for the variety of jobs around its gas plant and in pipe line construction has led to development by a midwest gas company, of a method of using the electric arc for reconditioning pipe. By following a definite formula for determining what pipe is reconditionable and then employing electric welding in accordance with a definite procedure, this company obtains worthwhile savings in pipe costs. The possible savings can be appreciated from the fact that the company never recon ditions pipe if the cost of reconditioning exceeds 25% of the original cost. Pipe which is excessively corroded is not reconditioned. However, the amount of pipe of this sort is not large. As a matter of fact practically all of the pipe removed from the ground is capable of being reconditioned.

The reconditioning method employed, in addition to permitting substantial savings, restores the pipe to a condition shown by test and appearance to be approximately 85 per cent as good as new pipe. In other words, reconditioned pipe, placed back in service, may reasonably be expected to last practically as long as new pipe.

Fig. 1. Reconditioning gas line pipe: Chipping out pit holes and marking them with chalk.

Fig. 2. Filling pit holes by electric arc process of welding.

Fig. 3. Pitted pipe welded by the electric arc.

Fig. 4. Pipe reconditioned by electric welding being tested by soap-sudding and pressure.

The work of reconditioning pipe involves closing and filling pit holes caused by corrosion of the metal. From knowledge of and experience with the soil conditions of the terrain through which its lines run, the company can usually tell with fair accuracy where pipe will need reconditioning. Such localities are taken care of as regular routine. In other instances, as when lines are replaced for one reason or another, or when a line is to be renewed, the pipe is checked over and, if necessary reconditioned before it is re-laid.

The procedure for reconditioning pipe is as follows: After the pipe has been removed from the ground, all dirt is cleaned off by a mechanical pipe cleaner. The pipe is then piled at the end of what resembles a production line. The first step is to go over the surface of the pipe with a pointed hammer and disclose all pits. (See Fig. 1). Long practice in gauging depths of the pits reveals any which are more than 1/10-inch in depth. Where the wall is badly pitted and most of the holes are more than 1/10-inch deep, the pipe is scrapped. Where pits do not exceed the 1/10-inch depth, the pipe is prepared for welding by going over its entire surface with the hammer, digging out corroded metal from the pitted area and indicating each pit by encircling it with a chalk mar, as shown in Fig. 1.

Following chipping out of the pit holes and indicating them by chalk, the pipe is rolled along timbers into the welding booth. There the arc welding operator fills all pits. (See Fig. 2). The work is done quickly and easily. The arc welding operator places an electrode (mild steel) in his holder, adjusts his protective shield and strikes the arc by touching the tip of the electrode on the pipe at the pit. No more than a minute is necessary to fuse new metal into the average-sized pit. This operation is repeated until every pitted spot is filled. Fig. 3 shows a number of lengths of 20-inch diameter pipe which have had pit holes filled by the electric arc. All welding shown in reconditioning the pipe is done with "Fleetweld" electrodes and "Shield-Arc" welders.

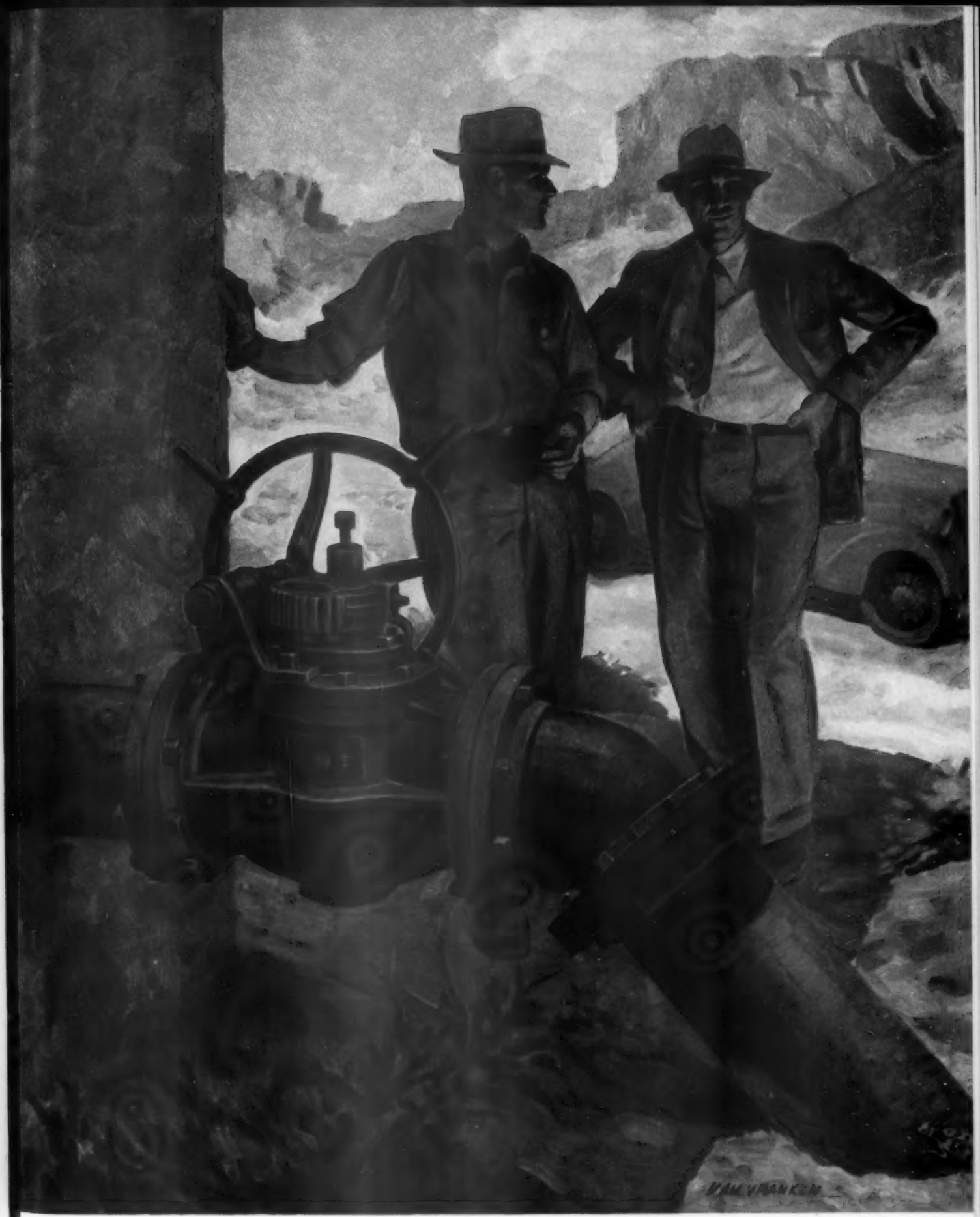
Electric welding has been found the most efficient and economical method of repairing pitted pipe. No preheating is necessary. The operator merely touches the electrode to the work, holds the position for an instant to deposit the metal and the pit is filled.

As the pipe comes from the arc welder it is thoroughly tested. (See Fig. 4). The test consists in closing the ends of the pipe, soap-sudding the outer surface, introducing pressure into the pipe and inspecting it for bubbles. This is part of the routine; and rarely, if ever, are any leaks discovered. Any that are found are quickly sealed by the welder.

The clamp used to seal the pipe is a simple one. It consists of part of a coupling assembly with a cap, a ring for bolting around the pipe, two rods fixed to the ring and threaded at the outer end for tightening bolts on the outside of a piece of channel iron. Tightening the set screws in the ring, locks it to the pipe. Tightening the nuts on the ends of the two tie rods draws up the cap and seals the end of the pipe. Each reconditioned pipe which passes the soap-sudding test, is then ready for re-use.

Approximately 800 tons of pipe consisting of 16-, 18- and 20-inch diameter were reconditioned last year in the manner described. The company expects to recondition an equal tonnage this year by the same method.

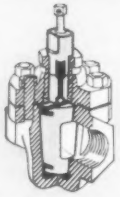
Who can this be? Is it F.D.R. tightening up on Federal Spending? No siree! It's William C. Troy of South Bend, Ind., long an employee of the M. B. Skinner Company.



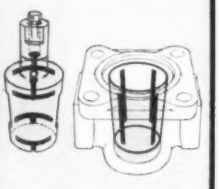
"Can you really 'get by' with only one valve 'way out here?"
"Sure; one's enough for positive shut-off, Chief. It's a Nordstrom."

PERFECT APPLICATION OF A PRINCIPLE

Study this picturized demonstration OF A **NORDSTROM VALVE**

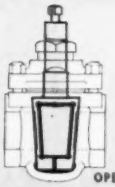


1 Cut-away view of 3" Nordstrom Valve, to reveal lubricated plug in position.

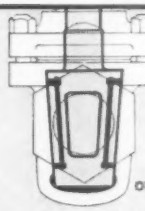


2 Simplified view, same valve, with plug lifted out, showing lubricant grooves in plug and body.

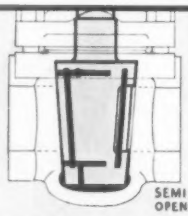
3 Hydraulic pressure forces plastic lubricant through plug channels to outer, upper grooves by turning screw.



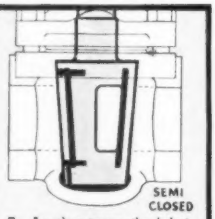
4 Grooves in plug connect with grooves in body, making circuit for lubricant to reach bottom plug grooves and maintain pressure.



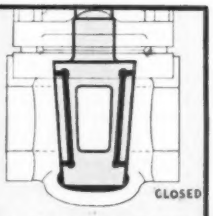
5 Port side of valve (valve open) with plug in same position as figure 4. Note the unbroken pressure circuit.



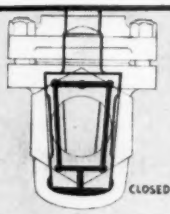
6 When plug turns to shut off valve, lubricant pressure is cut off from vertical groove in body **exposed** to plug port.



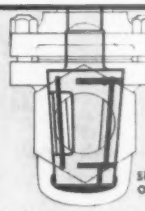
7 As plug turns, the lubricant pressure circuit is unbroken because vertical groove **unexposed** to plug port connects top and bottom grooves.



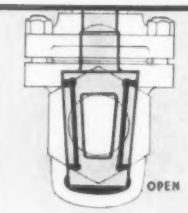
8 Plug is now at 90° turn, completely shutting off valve. Vertical groove exposed to plug port re-joins horizontal grooves of plug



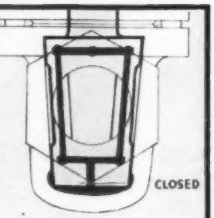
9 View of valve, port side Pressure lubricant grooves form a continuous seal around the closed valve port.



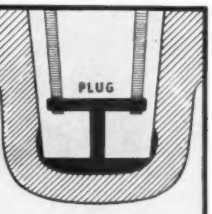
10 Reversing the operation to turn on valve. Vertical body groove exposed to plug port is relieved of pressure because the plug grooves break the circuit.



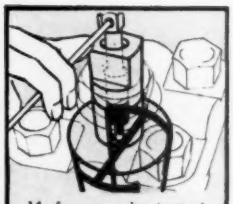
11 Valve in full open position presents unrestricted passage of line contents, but lubricant seal protects surface of plug



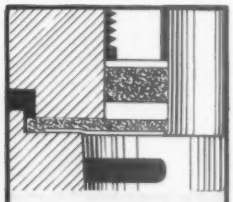
12 When valve is closed, ring of pressure lubricant effectively seals the entire port of the valve



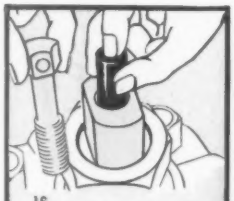
13 Under plug, a lubricant chamber forms hydraulic lifting means, to lift tapered plug from its seat.



14 Assume valve is stuck. Operator simply turns screw. This increases pressure on lubricant through grooves and to bottom chamber which lifts plug sufficiently to free it.



15 No long stuffing box needed. Packing is frictionless, unexposed. Positive seal formed by metal diaphragm.



16 **NORDSTROM** Lubricant in plastic stick form is inserted. Specially compounded for specific temperature and chemical conditions.

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NORDSTROM VALVES

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PATENTED "SEALOPORT" LUBRICATION

The Competitive Position of Gas Today in Southern California

By Harry L. Masser

Vice-President & Asst. General Manager
Los Angeles Gas & Electric Co., Los Angeles, Calif.

BOULDER DAM, a name much publicized during the past five years, has been the symbol around which the electric industry has endeavored to place a cloak of magic and mystify our people with the supposedly all-embracing wonders and superiorities of electricity over all other forms of energy for every purpose. Propaganda and advertising are powerful forces and necessary tools for commercial effects; however, in the long run, fundamental and basic facts do not yield merely to novel ideas. Energy in the form of natural gas still has beneath it a firm foundation of merit. However, the success of no industry continues in a perpetual-motion-like manner under that passive smile of its management. None of us can feel that all is well, and complacently let our business take care of itself, or soon our job will be easy with no business to worry about. I think that the demands for self-defense in the gas industry are as well appreciated in Southern California as anywhere in the country, because of the two-fold competition which here exists; namely, cheap oil and low electric rates. Our friends in other sections of the country are interested to know what Californians are doing to strengthen and defend the position of the gas business, and I shall therefore endeavor to outline some of the courses we pursue.

Since the early 90's, gas has held the commanding position as a fuel in this locality, and beginning in 1915 this position has been improved due to the development of great reserves of natural gas close to the market. This development of course brought fuel oil along with it, but it is only within the past five years or so that electricity has become a real contender to cope with. Now we are confronted with even a surplus of "spill" hydro-electric energy which is seeking a market at highly competitive rates. Fortunately for us, our service generally was already in use; so again "possession has been nine points" in advantage. Our transmission lines total nearly 1,500 miles in length and connect every important field with the market; therefore our job now is essentially that of selling.

HARRY L. MASSER

Much attention has been given by sales executives to the subject of rates, and rightly so, for in many localities where the heating value of the gas is low and costs relatively high, the cost per effective gas B.t.u. approaches closely to the cost of an electric or other competitive B.t.u. However, in Southern California this is not so nearly true, for here, under the cheapest blocks of both general service schedules, the cost of the utilized gas B.t.u. is only about one-third or less of that of the utilized electric B.t.u. Gas rates have been continually reduced since the advent of natural gas, and the new schedule becoming effective for general domestic service in the Los Angeles area, on April 1, 1937, for 1100 B.t.u. gas is:

First	300 c.f.	or less	$.80	min. per	meter
Next	1,800 "	at	6.8c	per hundred	c.f.
Next	1,900 "	at	5.8c	" "	"
All over	4,000 "	at	5.0c	" "	"

Electric schedules generally start with a moderate sized block, at about 4.5c/kw.-hr., dropping to 2.0c, and with special rates of from ¾c to 1c for off-peak water-heating.

From the above figures, it will be apparent that gas costs have the outstanding advantage in regard to economy; but in spite of this we must go further into the situation. As to house-heating and commercial space heating, where large and rapid B.t.u. inputs are required, gas now holds the market with little dispute; this, however, is not so true in regard to cooking, refrigeration and water-heating. Electrical costs for these latter three services have been reduced, particularly under "inducement" forms of schedules where rate declines rapidly if cooking, or cooking and water-heating are included with the lighting. It has therefore been necessary to establish corresponding types of gas rates to meet competition. One schedule recently in effect provided a discount of 15% from the general service rates on that portion of monthly bills between $2 and $25 when gas was used for the three purposes of cooking, water-heating and space-heating; in other cases special schedules lower than those for general service are effective where gas is used for two purposes, and other schedules for three purposes.

Gas Service Sold on Basis of Advantages

Such forms of rates as the above, designed to give extra competitive advantage to gas, are necessary, but they do not in themselves yield a complete answer. It is possible, for example, with certain combinations of equipment under local electric rates, to obtain the additional energy used for water-heating at no

added monthly cost. The more common situation is that, by addition of cooking to the base lighting load, the small family cooking cost electrically will be about $3 per month, with the possibility of a reduction of lighting cost. Therefore, we meet many cases where the cost of service is not the determining factor that will give the business to gas.

When the cost factor involved is only $1.50 to $2.50 per month between gas and electricity, there are numerous cases where the housewife disregards this if she has been high-pressured with the "electric idea," thereby placing the sale of gas strictly upon the basis of its advantages. For this reason in particular, I say that rates alone will not solve the whole problem; we must constantly keep the public informed of the merits of gas.

In order to keep the public "gas minded", the Southern California companies have developed a well-rounded program of sales promotion. Intensive sales campaigns have been conducted, such as that of two years ago when 13,000 clock-controlled gas ranges were sold in sixty days, and a similar one during 1936; special water-heater campaigns are promoted; cooking schools are constantly carried on; extensive advertising of all types directly tying in with the national program is always before the public, and last but not least is the sales department organization designed to cover all phases of the market problem. Much attention is given to coordination of the companies' sales efforts with those of appliance dealers.

The Los Angeles company, with which the writer is connected, does not sell appliances directly, whereas our sister companies in adjoining territory—Southern California Gas Company and Southern Counties Gas Company—do sell directly. With this situation certain uniformity of inter-company policies has been necessary. The following paragraphs outline briefly the divisions of the Los Angeles Company's sales department involved with appliance merchandising.

New Building Division

Men assigned to this work follow all new construction. Their signal to "go" is the knowledge obtained from building permits and all other sources that a new building is to be constructed. These men provide contractors, builders and owners with information relative to the advantages of an "all gas" house, and data on gas piping and the proper size and type of appliances to purchase and install. To perform this work satisfactorily, each man must live with every job in his territory from start to finish, and leave no stone unturned to accomplish his object of seeing that modern natural gas service is supplied to every structure.

Dealer Representative Division

The sales department receives prospects for new gas appliances from many sources within the company, such as appliance servicemen, load surveyors, display floors, model homes, cooking schools, and exhibits of various nature. All of these leads are cleared through the dealer representative. Prospects which are "hot" are given direct to a dealer in the prospect's territory; prospects who require more "selling" are interviewed by a representative, and the proper classification of the prospect as to the extent of interest is determined. In this manner, much of the ground work on prospects is accomplished for the dealer by the corporation. The work of the dealer representative division does not cease with the mere release of a prospect to a dealer. A "follow-up" system is employed to determine the eventual disposition of all prospects given dealers. Thus the corporation is automatically provided with an index relative to the effectiveness of the several sources of gas appliance prospects as well as of cooperating appliance dealers. Through these men the corporation has a direct outlet for the dissemination of information to appliance dealers. The dealer representative division not only assists appliance dealers to make more sales, but also provides tie-ins that bind the dealers to the utility in such a way that both receive benefits.

Architects' Division

Close contact with architects is most essential from a competitive standpoint, because we have found very definitely that architects must be kept constantly informed on new services and new appliances offered by the gas industry, and, further, because of the ever-changing building and appliance installation ordinances. Architects must be sold and kept sold on the benefits which their clients will enjoy as users of modern gas service.

The plumbing trade is a most important factor in connection with the sale of water-heaters, and its understanding of gas company policies and cooperation must be had. Meetings are held from time to time to keep this trade up-to-date. The same practice is followed with "stationary engineers" interested in the use of gas for commercial and industrial purposes.

Plumbers Gas Industry Institute held under the auspices of the Natural Gas Bureau, November 23, 1936.

Appliance Counsellor Division

Displays of modern gas appliances are maintained in the main office, district and branch offices. In charge of each display are qualified women appliance counsellors who furnish information concerning gas service and appliances, and assist dealers in increasing their volume of sales. Greatly improved results have been procured by having appliance displays directly on the floor where patrons pay their bills, so that the Counsellors may talk with the customer immediately upon noticing any evidence of interest in a range or heater.

Gas Cooking School sponsored by local newspaper. Ten thousand attended.

Home Service Division

In addition to routine home service work, this division directs many cooking schools. In cooperation with local newspapers, a number of most successful cooking schools have been conducted. The accompanying cut shows the attendance of nearly 10,000 at the *Los Angeles Examiner's* gas cooking school last year under the direction of Miss Victoria Warner. Appliance manufacturers, dealers, and food products companies tie in with these schools in a very effective manner by the giving of prizes and use of their products. Model gas kitchens and auditoriums are maintained in the district offices, which are available for group and individual demonstrations. This vitally important sales division advertises the story of the modernity, convenience, simplicity and economy of natural gas to many thousands of home-makers throughout our territory.

Consistent Sales Promotion

The employees of each of the various divisions must present their stories to interested people in simple, understandable language. The employees of one division must not tell a story that differs from one told by employees of any other division. Observance of this practice eliminates confusion in the minds of those persons contacted by representatives of more than one division. To standardize sales promotional work, a department has been established to collect and compile, in the most effective and useful manner, information covering new appliance data, sales plans, problems and solutions. Every sales employee is provided with a sales portfolio presenting salient facts about natural gas, modern appliances, and useful competitive data. The material is revised and supplemented as the need arises through new developments. This manual serves as a guide for the employee in his customer contact interviews, as well as a source of information for dealers; it also provides members of allied industries with information concerning new developments. Much of the data published in the sales manual result from employee sales conferences held at frequent intervals, where individual problems and their solutions are discussed and which result in a healthy exchange of ideas and opinions.

Corner of Model Kitchen in Hollywood

An appliance testing laboratory is maintained for extending the tests required by the American Gas Association Laboratory, in order to procure more complete knowledge of the service performance of various appliances, and to cooperate with the manufacturers in the further development and perfection of their various models. Extended field experience often demonstrates shortcomings in new appliances the correction of which is of material importance in the maintenance of the good service required for assuring satisfied customers and for minimizing service costs. Our laboratory is proving most successful in this field, and also in improving burner design for increased efficiency; excellent cooperation has been had between range manufacturers and the Laboratory.

Inter-Company Sales Cooperation

Because many of the problems faced by the three gas companies in the Los Angeles district are substantially identical, certain promotional activities are carried on as a three-company project. These joint activities cover certain advertising, appliance exhibits, appliance sales campaigns and educational programs which are conducted under the direction of our Natural Gas Bureau. Some of the activities of this bureau are described in the following paragraphs.

In February of 1934 a clock-controlled gas range campaign was conducted for a 60-day period, and during that period customers could purchase a Grayson clock range at the standard price of the non-clock range, under the following arrangement: Manufacturers and distributors supplied dealers with clock-controlled gas ranges at the price of the range without the clock; the utility paid the manufacturer or distributor

$20 for each clock range properly installed on its lines. All ranges had to be A.G.A. approved and retail for not less than $89.50 without the automatic clock. The results far exceeded the expectation of any of the participating groups. The sales executives estimated that they would be fortunate indeed if they could place 3,000 ranges in 60 days. But the public bought over 3,000 ranges in the first three days. At the end of the campaign, results indicated a high total of over 13,000 clock-controlled gas ranges sold in 60 days, ringing the cash register for dealers to the tune of $1,200,000. This same type of campaign, with one major change, was repeated during the latter part of 1936. The regular demand for clock-controlled ranges had been so pronounced that the utilities were able to reduce their subsidy from $20 to $11, which resulted in at least 12,500 more clock-controlled gas ranges bringing joy to their new owners.

All fairs, exhibitions, food shows, model homes, and allied activities in which it is desirable for the natural gas industry to have exhibits of modern appliances, are handled by the Natural Gas Bureau. Various educational meetings with groups of representatives of associated industries, such as plumbers, hardware dealers, and manufacturers, are bureau functions. These activities, centered in the Natural Gas Bureau, have enabled the gas industry of Southern California to present a uniform story of natural gas, enabling the industry to reach many thousands of persons and have resulted in an economy of time, effort and money.

From this brief discussion, it should be evident that great emphasis is placed upon sales promotional efforts by the gas companies of Southern California. Sales promotion, however, is only one of the tasks to be performed. The more than 900,000 customers of the natural gas industry in this area are kept sold on gas service because those departments whose functions are transmission and distribution provide that quality of service necessary to make sales stories come true. The existence of keen competition from other fuels is appreciated and recognized, but not to the point that profitable selling methods are being replaced by selling of a negative or questionable value.

John H. Grayson Awarded Addison B. Day Medal

John H. Grayson, famous in the gas industry for the invention of an automatic time control for gas ranges, former executive head of Grayson Heat Control, Ltd., and at present conducting independent experimental and research work at his laboratory at Lynwood, California, was awarded the Pacific Coast Gas Association's highest mark of recognition in the form of the Addison B. Day Medal of Honor on April 2 of this year.

On but two previous occasions have the Board of Directors of this association considered any single individual's contribution to the industry to be of sufficient magnitude to warrant bestowal of this coveted award.

Addison B. Day, president of the Los Angeles Gas and Electric Corporation, in presenting the medal to Mr. Grayson, said:

"In selecting Mr. Grayson as the third member of the exclusive group who have received this award, we hope to express some measure of our admiration and gratitude for his inestimably valuable contributions, not only to the gas industry, but to the nation as a whole. I sincerely believe that the heat control devices which his inventive genius has given to the world are among the most important developments of this century."

Considered the nation's leading authority on gas combustion and unquestionably the most brilliant inventive genius in his own particular field, Mr. Grayson has to his credit a number of important heat control devices beside the automatic clock control. His earliest—a snap-action thermostat for gas water heaters—was perfected in 1927.

Prior to that time he was employed in the Bureau of Standards and the Bureau of Mines, specializing in problems of gas combustion. His work in this field was so outstanding that his services were sought by the gas industry, and he spent some time lecturing before groups of gas engineers over the United States.

With the perfection of his first heat control device, he came to Los Angeles, electing to manufacture the mechanism rather than sell the patents. At Lynwood, California, he established Grayson Heat Control, Ltd., the success of which was immediate; and almost immediately he came out with a safety pilot, a device which automatically shuts off the gas supply when the pilot flame on a water heater is extinguished.

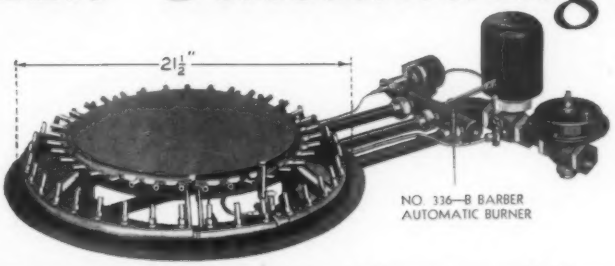
The automatic clock control, most elaborate and ingenious of his inventions, was first produced in 1932. This mechanism consists of a time clock which may be set to control the opening and closing of gas valves at predetermined times, automatically lighting and extinguishing the flame on a range burner. Simple, labor-releasing, effective, it has gained wide public acceptance and is rapidly becoming standard equipment on the modern gas range.

In recent months Mr. Grayson relinquished control of Grayson Heat Control, Ltd., selling his interest and arranging for the sale of stock in the company to Reynolds Metal Company of New York. A unique testimonial of his business as well as his inventive genius was a dinner given him by his stockholders at which a loving cup was presented him in gratitude for his able handling of the affairs of the company.

Coincidentally with his receipt of the Addison B. Day Medal of Honor further recognition of his unique abilities was accorded him by the American Gas Association. Herman Russell, president of the association, wired a congratulatory message on the day the award was presented, expressing the entire gas industry's debt of gratitude to Mr. Grayson.

On presenting the award Mr. Day congratulates Mr. Grayson.

An Outstanding Line of BARBER BURNERS Offers You Products That Will SELL and PERFORM



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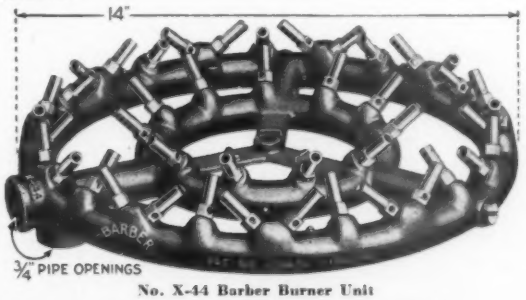
Made in eight different sizes to handle round grate diameters from 12" to 34". Also tailor made to suit and fit the grate dimensions of oblong furnaces and boilers. Insures proper scrubbing flame action on side walls of firebox, and the 1900° Flame Temperature develops the highest possible efficiency and economy. Equipped with Baltimore Safety Pilot for positive and accurate Safety control. Listed in the A. G. A. Directory of Approved Appliances.



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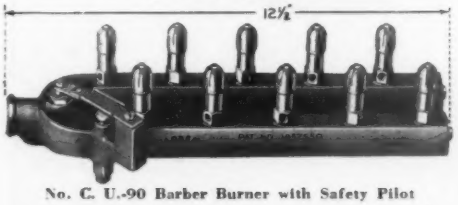
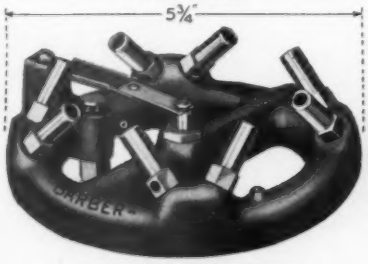
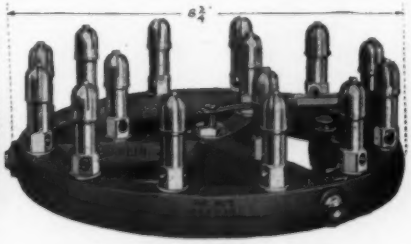
A FAR MORE complete range of improved Barber Products now awaits your acceptance. It's worry off your mind, to familiarize yourself with Gas Burning Equipment which is really PERFECTED. Shown here are merely a few items from Barber's wide selection of Gas Burners for numerous Appliances, Gas Pressure Regulators, and Controls. Get the WHOLE story! We offer you the experience and facilities of our Engineering Department for your Gas Burner problems. Write today for No. 37 Catalog and Revised Price List.



No. C. U.-90 Barber Burner with Safety Pilot



No. S. P.-15 Barber Burner with Safety Pilot



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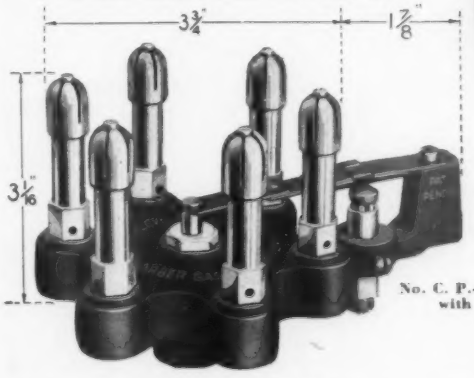
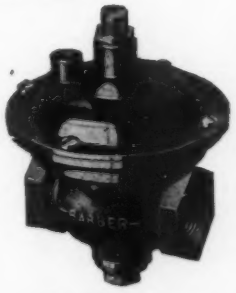
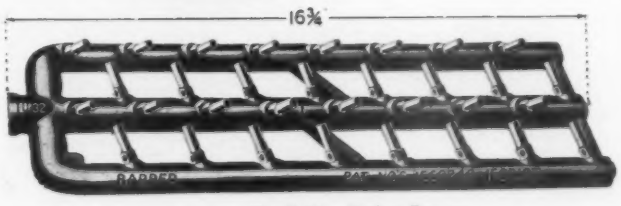


No. C. P.-61 Barber Burner with Safety Pilot



Barber Gas Pressure Regulators A.G.A. Approved

Made in the following sizes: ½", ⅜", ½", ¾", 1", 1¼", 1½", 2".



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BARBER BURNERS and Regulators are Adaptable to Such Appliances as:

- Air Conditioning Equipment
- High Pressure Boilers (Tubular and Tubeless)
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THE BARBER GAS BURNER CO., 3704 Superior Ave., Cleveland, Ohio

Address Michigan Inquiries to The Barber Gas Burner Co. of Michigan, 4475 Cass Ave., Detroit

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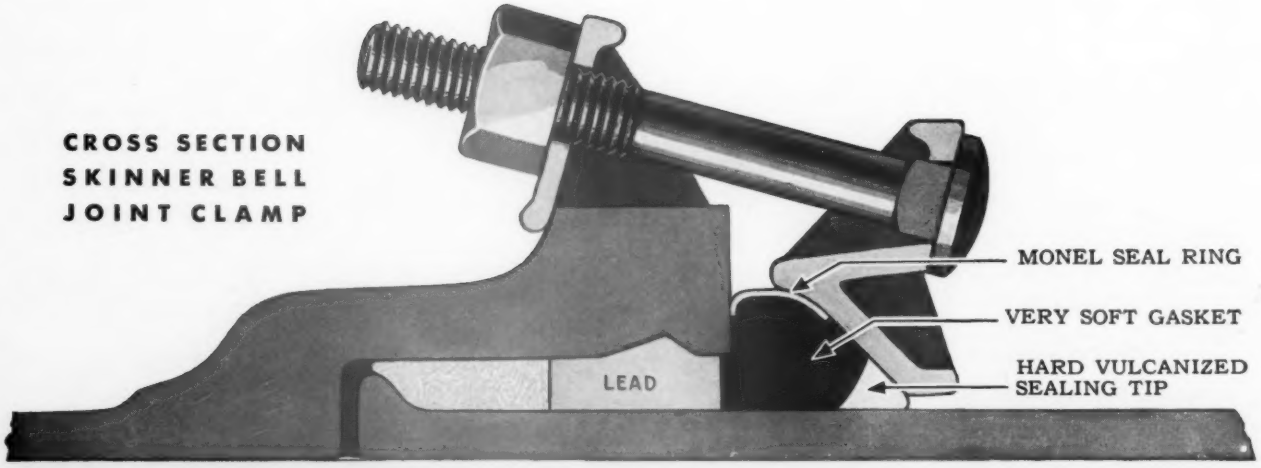

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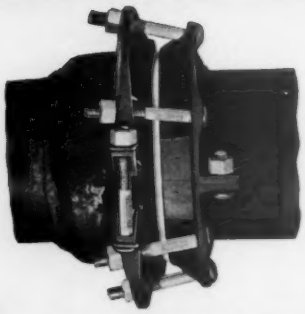

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Natural Gas Measurement

A Chronology of Its Modern Development

By

John C. Diehl

Chief Engineer
American Meter Company

FOR many years after its initial acceptance for domestic lighting and fuel requirements, natural gas was sold on a flat rate basis. The consumer paid a fixed amount—or, subsequently, was charged at various rates depending primarily upon appliances used.

When it was definitely determined that the natural gas supply was not inexhaustible, prudence indicated the necessity of measuring the gas, so that each customer might pay his proportionate share for gas and service received. Only by some such method of rationing—of measuring—could wilful waste be prevented and Nature's most valuable fuel be conserved.

During this period, it was not possible to obtain satisfactory regulators for reducing the high pressure of the natural gas wells to low pressure at points of consumption The domestic tinned steel case meter—developed for the manufactured gas industry—was not considered suitable for use, because of the ever-present possibility of high pressure entering the meter. This brought about the introduction of the iron case meter.

Proportional Meters

Long after natural gas was measured for domestic purposes, it still was sold in the field at a flat annual rate per well, even though the quantity obtained might vary over wide limits. It then became necessary to develop a meter for the measurement of large volumes at high pressure. This demand was filled for many years by the proportional meter, in which a definite percentage of the total volume was measured through a small meter, and by means of gearing the total quantity passing through the meter was indicated on an index. Its case of cast semi-steel possessed sufficient strength to withstand the high pressures in the line. The application of multipliers was introduced to convert the volume of compressed gas actually measured by the meter into a volume which the expanded gas would occupy if or when measured by a meter at low pressure. Several types of volume and pressure gages were invented for installation

JOHN C. DIEHL

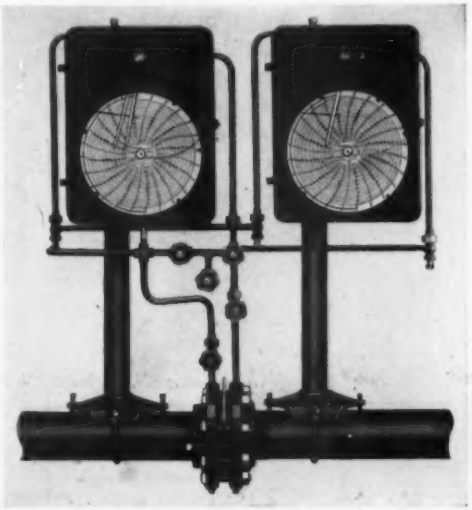
on proportional and iron case displacement meters. These gages recorded the pressure at which each unit volume of high pressure gas was measured.

Pitot Tube Method

In order to reduce the size of meter and to measure very large volumes at high pressure, the Pitot tube method was developed and introduced by B. C. Oliphant in 1910. The section of pipe in which the Pitot tube was inserted was made of special material, with a polished interior surface at least 40 diameters long. A definite advance in the art of measuring gas! . . . by the novel method of indicating the difference between the impact pressure produced by the flow, and the static pressure—which depended upon the velocity. The volume was computed by calculation from the velocity and the time.

Orifice Meter

Concurrently there arose a demand for a less expensive type of layout and method, which could be used in lines of all sizes, and from which the volume could be determined from differential and pressure. To meet this need, the orifice meter method of measurement was developed in the fall of 1911, by John G. Pew and H. C. Cooper of the Peoples Natural Gas Company. After six months of experimental work, it was determined that the theoretical formula developed for the Pitot tube would apply for the orifice. It then became a matter of experiment to evolve the proper shape of the orifice and that method of making the connections which would give the most consistent results. These tests were made at the reducing station of the Peoples Natural Gas Company where its main line entered the city of Pittsburgh. They were conducted under actual working conditions at a point where any desired pressure up to 160 pounds could be secured, and any volume up to 50,000,000 cubic feet a day was available. Upon completing the tests, in November, 1911, the first orifice meter for measuring gas was



Combination
Setting Orifice Meters

installed in the lines of the Hope Natural Gas Company in West Virginia. In these tests, the differential taps were made at one inch from the face of the orifice. The upstream pressure was recorded as the static pressure, and the orifice was beveled on the downstream side.

Weymouth Tests

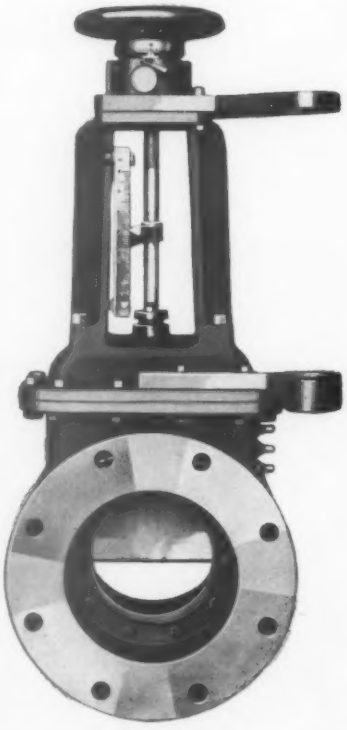
In 1913, Thomas R. Weymouth also conducted tests for the United Natural Gas Company of Oil City, Pennsylvania. He finally decided on the same type of differential connections as had the Peoples Natural Gas Company, but used the downstream pressure as the static pressure.

Empire Companies Tests

In 1913, the Wichita Pipe Line Company, now the Empire Companies, ran an extensive series of tests under the direction of E. O. Hickstein. They adopted the setup used in experiments conducted at Charlottenburg, Germany, in 1907, and further adopted the connections at 2½ diameters ahead of the orifice and 8 diameters at the outlet of the orifice. In these tests, the upstream pressure was used as the static pressure.

Differential Gages

After these companies had completed their original tests and had determined the adaptability of the orifice plate as a method of measurement of large volumes of high pressure gas, also the value of the coefficient, it became necessary to develop a gage which would record the differential or drop in pressure from one side of the orifice to the other. At the time of the first experiments, no instrument was available for this purpose. It was found, however, that one of the gage manufacturers made a recording gage that would record the pressure in inches of water.



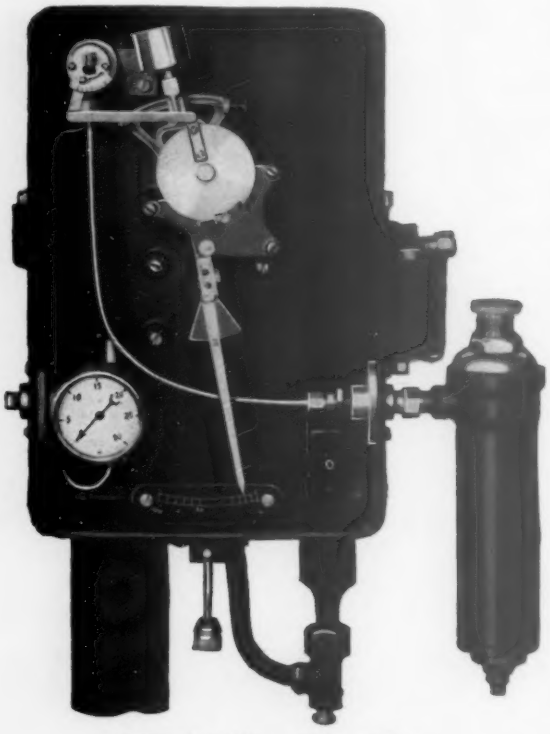
Wide Range Orifice

In the fall of 1911, a differential gage commonly called the "bomb shell" type was developed by the Peoples Natural Gas Company. It consisted of a large high pressure casting inclosing the recording gage. The differential was recorded on the gage by admitting the upstream pressure to the interior of the pressure spring when the downstream pressure surrounded the pressure spring and the recording gage. The static pressure was recorded by an independent pressure recording gage.

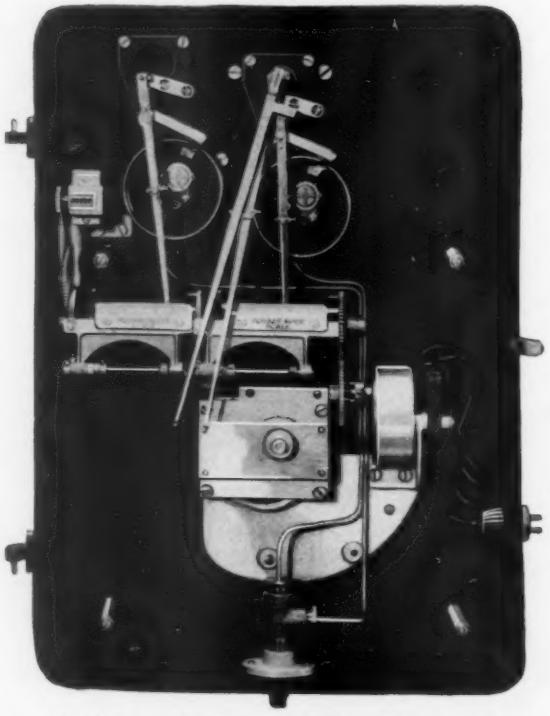
Gage manufacturers immediately took up the work of designing a differential gage. During the next few years, a number of gage types using springs and mercury chambers were placed on the market, with the result that the mercury float type has been generally adopted by the orifice meter manufacturers.

Experiments—and Orifice Meter Improvement

Although the meters continuously have undergone improvements to give more dependable service and greater accuracy, the United States Bureau of Standards, the gas associations, the natural gas companies and the manufacturers have conducted extensive and at times costly experiments to improve the accuracy of measurement and to formulate definite specifications for the installation of meter settings.



Differential Valve—Orifice Meter



Inside View of Integrating Orifice Meter Case with Chart Dial Removed.

The natural gas industry has been very diligent and aggressive in these efforts. All of the larger companies have measurement departments which inspect and maintain the meters, and calculate the charts. The heads of these departments are well versed in gas measurement principles, and in interpreting clauses in contracts relating to the principles of measurement.

Since the introduction of stainless steel, many of the orifice plates are made of this alloy, the composition depending upon the particular corrosive qualities of the gas. Forged steel orifice flanges are used quite generally. All meters are assembled with machined parts of stainless steel. This material is used also in the manufacture of high and medium range pressure springs, being especially desirable for the measurement of gas which corrodes springs made of various copper alloys.

Recent Developments

The developments in the measurement of natural gas during the past fifteen years cover every phase of application, namely:

- Specifications for orifice meter installations
- Square root charts
- Square root planimeter
- Chart calculators
- Orifice fitting
- Multiple meter settings
- Integrating orifice meters
- Specific gravity apparatus
- Low pressure flow provers and critical flow provers
- Pressure and volume integrators

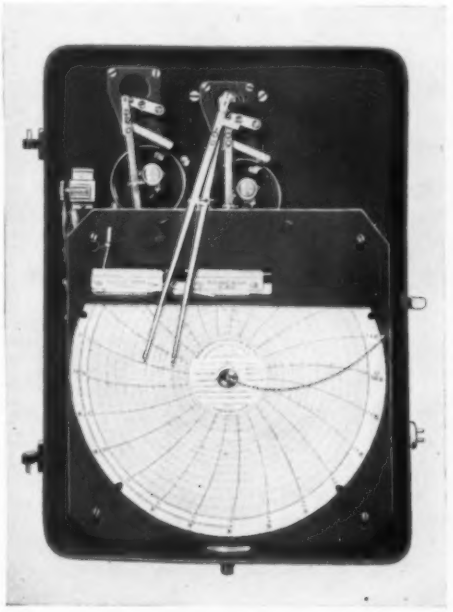
Orifice Tests and Data

The first orifice meter publication which supplied information regarding coefficients or constants, gave the coefficients for pipe taps. It was distributed in 1918. In 1921, data and information on the use of coefficients for flange taps were published in a handbook. About 1922, the Bureau of Mines issued specifications for orifice meter computations covering pipe and flange taps for the Osage Nation.

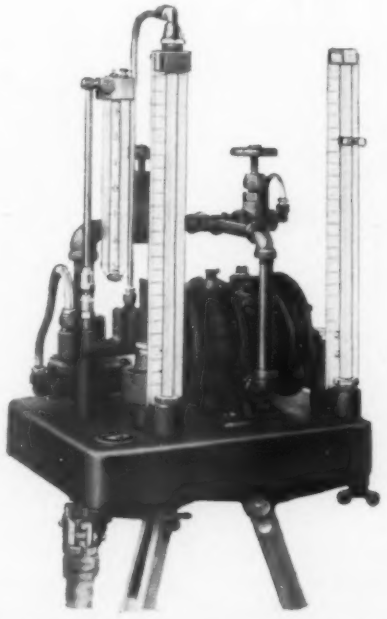
The Bureau of Standards, at the instigation of the Bureau of Mines and in connection with the measurement of gas on government lands, initiated tests on orifices in 4-inch, 6-inch and 8-inch lines at Edgewood Arsenal, Maryland, in 1921. The results of these tests were recorded in Research Paper No. 49 entitled, "Discharge Coefficients of Square Edged Orifices for the Measurement of the Flow of Air," published in 1929.

In November, 1924, the Gas Measurement Committee of the Natural Gas Department of the American Gas Association held a preliminary meeting and discussed the problems of correct methods of installation of orifice meters for measuring natural gas, the necessary factors and the operative requirements in the use of such meters. During the summer of 1925, and extending over a period of six years, the Committee conducted several research projects. In 1927, it published a preliminary report, which was revised in 1929. The Committee also issued Report No. 1, in 1930, which embraced the specifications for construction and installation of orifices, straightening vanes, fittings, and use of coefficients. After considering all of the data obtained by them up to that time, the Committee recommended—in Report No. 1—the continued use of the published coefficients for orifice meters installed in accordance with the methods set forth in that report, when the differential in inches of water was not greater than the pressure in pounds per square inch absolute.

In September, 1931, the Committee joined with the Special Research Committee on Fluid Meters, of the American Society of Mechanical Engineers, and formed a Joint Committee on Orifice Meters, for the purpose of obtaining harmony in any future publications on orifice meters. In May, 1935, this committee presented Report No. 2, containing specifications for the construction and installation of orifice plates, pipe runs, straightening vanes, orifice flanges and fittings; location of pressure tap holes and thermometer wells. It also included the orifice constants for air based upon the theoretical conditions that the differential divided by the absolute pressure is zero, and the viscosity is zero. This report contains tables of factors which, properly applied, permit the accurate measurement by orifice meters over a much wider range of conditions than formerly was possible. After its publication, the gas man's vocabulary was enlarged by such terms as Reynolds' Number, Viscosity, Specific Heats, and Expansion Ratio.



Inside of Integrating Orifice Meter Case, with Chart Dial and Segment of Chart in Place.



Indicating Gravitometer Mounted on Tripod, with Case Removed.

Square Root Charts

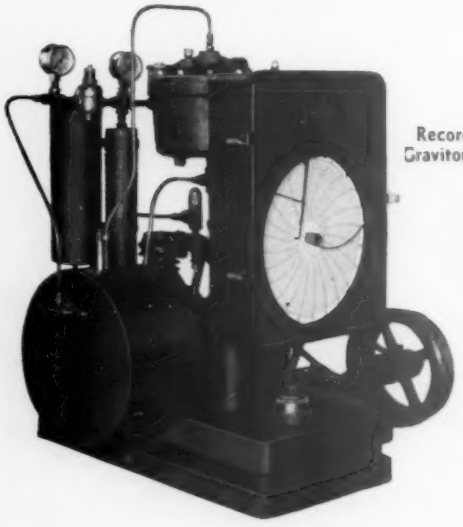
When these charts are used in accordance with the instructions relative to the testing of the pressure pen at atmospheric pressure, it is possible to use the same charts in all orifice meters regardless of the differential or pressure range. The product of the differential reading, the pressure reading and the unit hourly coefficient enables the operator to determine instantly, without resorting to pressure extension books, the rate of flow at any period . . . The chart calculations can be obtained more rapidly by use of a table of multipliers than by the use of ordinary charts and pressure extension tables.

Chart integrators or Planimeters were devised for determining the average value of the square root of the differential or the square root of the pressure. These instruments afford accurate results regardless of the variation of the differential. When the pressure varies widely, daily readings may be divided into two or three periods of constant pressure, thus obtaining accurate results.

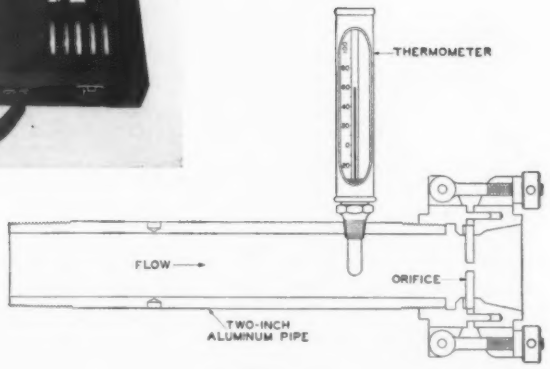
Chart Calculators

The chart integrator or calculator gives the summation or integration of an infinite number of instantaneous values of the square root of the product of the absolute pressure and of the differential values, on a counter. Each instantaneous value of the pressure is synchronous with its corresponding value of the differential. In operation, the chart is affixed to a plate rotated by an electric motor. Two pen arms carrying fountain pens extend over the plate in contact with the chart, and are attached to two handles on the front of the machine. By manipulating the handles, the operator simultaneously traces the static and the differential lines on the chart as it is rotated. The fountain pens leave faint blue lines superimposed over the original chart curves for the purpose of checking the operator's accuracy. The chart plate automatically makes one complete revolution and then stops, while the speed of rotation is governed by the operator's use of a foot control.

Critical Flow Orifice Prover, including Nipple, Five Orifices, Spanner Wrench, Thermometer, and Stop Watch, in Carrying Case.



Recording Gravitometer



Critical Flow Prover Application.

Orifice Fittings

Changing the capacity of an orifice meter involves removing the plate and inserting another plate in the line. This operation is facilitated by employing an orifice fitting in which the orifice is installed in a special fitting—its use eliminating the installation of a by-pass. During the short time required to change the plates, the gas flow is uninterrupted.

Multiple Meter Settings

The orifice meter is a comparatively simple instrument, adaptable for measuring very low rates as well as very high of flow; although with one orifice and one differential gage, the ratio of maximum to minimum range seldom exceeds 3½ to 1. Due to the simplicity of installation and the comparative economy of orifice meter settings, it is desirable to use auxiliary devices to increase the range.

Combination Settings

When the ratio of maximum to minimum flow exceeds the capacity of a single meter, a combination or duplex installation of a 100-inch with a 10-inch meter increases the capacity 3¼ times. This type of installation is especially suitable for measurement at town-border lines. Both meters are attached to the same taps in the lines. Both record the flow until the differential exceeds 10 inches. When the readings are less than 10 inches, the readings of the 10-inch meters—which are the more easily determined—are used in the calculations. Above 10 inches, the records of the 100-inch meter are used. During the higher rate of flow above 10 inches, the record of the 10-inch meter chart is continuous beyond the outside range of the chart. The 10-inch meter is assembled with a long seal connection between the two chambers of the meter so that the gas never passes through the meter. The pressure is recorded on both charts, or on only one of them. Another combination frequently used is the 20-inch meter with the 100-inch meter.

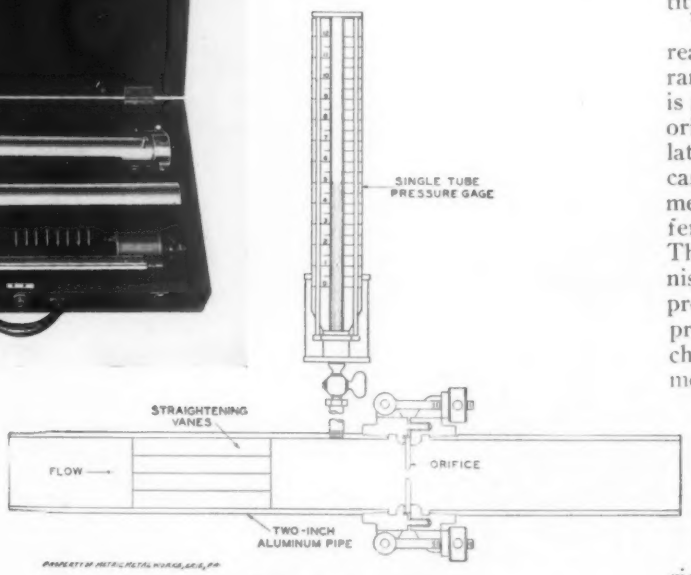
Wide Range Orifice

This is a device for increasing the orifice meter range without need of changing the orifice. Such orifice is essentially an accurately machined slide which moves vertically over the face of a circular orifice fastened rigidly in a valve body. The slide is moved upward and downward by a hand wheel which rotates a threaded rising stem of constant lead. Each revolution of the wheel represents a definite movement of the slide. When the slide is raised, the effective area of the orifice is increased from zero to the maximum area of the circular orifice. The hand wheel can be locked in any position at each full turn, so that there are—for certain sizes—60 locked positions of the slide which correspond to 60 sizes of fixed orifices. As the rate of flow increases from time to time, the area of the orifice or the coefficient of the orifice can be increased or decreased

without removing a plate from the line and substituting another plate. The coefficient for each locked position of the orifice is determined by test with a bell type prover or a multiple orifice prover. The distance that the slide is above the zero position is indicated on a scale fastened to the valve yoke by a pointer attached to the stem.

A former method of increasing the measurement range of orifice meters consisted of the installation of orifice meters in parallel runs. A differential regulator, installed in the secondary run, was connected across an orifice in the primary run. When all of the flow passed through the primary run and the load increased so that the differential exceeded the maximum rate of flow which could be measured by the meter in that run, the differential caused the differential regulator in the secondary run to open, and the gas to be measured by the meters in the two runs. When the rate of flow decreased and the differential became less than that which could be accurately determined on a chart, the low differential caused the differential regulator to close and all of the gas to pass through the meter in the primary run.

Low-Pressure Flow Prover in Case.



Low-pressure Floor Prover Application.

Differential Valves and Other Devices

Recently devices have been installed in orifice meters, or independent of the meters, to accomplish the purpose described in the foregoing. These devices admit gas at high pressure to the top of the diaphragm of a regulator, in order to close the valve of the regulator in the secondary run when the differential is within the maximum range of the meter in the primary run. Such device automatically permits the accurate measurement of low rates of flow by one meter, and larger rates of flow by two or more meters located in parallel lines, so that the minimum as well as the maximum rates of flow can be measured with the same degree of accuracy. The differential valve, which is independent of the orifice meter, is an instrument used for this purpose. Its use permits the minimum rate of flow to be measured either by a small orifice or by a displacement meter, whereas the maximum rate of flow can be measured by a combination of a displacement meter or an orifice meter in the primary run and an orifice meter in the secondary run.

When the valves should be closed, the full line pressure on the diaphragm of the valve is available, if necessary, to prevent any leakage; although the valve never has to be closed against a pressure of more than 100 inches of water. When the valve should be open, the pressure on the diaphragm is reduced to atmospheric pressure.

Integrating Meters

Considerable thought and ingenuity have been expended in the development of devices for automatically obtaining the summation of the pressure extensions of orifice meters. While it is possible for those familiar with orifice meter charts to determine by inspection the approximate rate of flow or the quantity passing through the meter in a limited period of time, the quantity cannot be determined readily by those who are not dealing with them constantly. Therefore it became desirable for certain types of installations, especially those where gas is sold to industrial plants by orifice meters, to develop a device which would enable the operator to determine the quantity of gas that passes through the meter daily. Or, when the gas is used for certain operations, it might be advisable to know the quantity each hour.

To overcome the difficulty of reading charts, many different arrangements have been proposed. It is now possible to have an integrating orifice meter in which all the calculations are made in the same size of case as that of the former orifice meter which recorded only the differential and pressure on the chart. The integrating orifice meter furnishes a record of the differential and pressure and also summation of the pressure extensions at any time. The chart is rotated by a Telechron motor, and the integration device is turned by the same motor. Briefly, this instrument multiplies the square root of the differential by the square root of the pressure each minute, and totalizes the summation of the products. At the end of any period, the reading obtained from the instrument, multiplied by a unit coefficient, enables the operator to know the quantity which passed through the orifice. The operation of the integrator is continuous, while the primary multiplication is performed once a minute.

It is possible also to obtain integration from a duplicate installation of orifice meters. In this instance, the orifice meter of the lower differential range totalizes the pressure extensions up to the maximum capacity of the meter, and at the maximum capacity. When the flow exceeds the maximum capacity of the meter, the integrator of the second meter totalizes the pressure extensions beyond the range of the first meter up to the maximum capacity of that meter. The sum of the pressure extensions obtained from the two meters enables the operator to determine the total quantity that passed through the line.

Specific Gravity Apparatus

A knowledge of the specific grav-

ity of natural gas is required in measurement by orifice meter and in testing displacement meters by any of the orifice meter methods such as the funnel prover, the low pressure flow prover, or the critical flow prover. Special attention has been devoted to the development of specific gravity apparatus. The specific gravity balance that is generally

Pressure Intergrator for Displacement Meter.

used for field work is an enlargement of the Edwards Balance—primarily a laboratory apparatus. In this apparatus, the specific gravity is the ratio of the absolute pressure required to maintain the light hollow bulb in a neutral balanced position in air, divided by the pressure required to hold the bulb in the same neutral balanced position in gas, the gas and air being at the same temperature.

One type of indicating gravitometer indicates the specific gravity of the gas, which is the pressure produced by the rotation of a fan at a certain speed in a chamber filled with gas, divided by the pressure produced by the rotation of the same fan at the same speed when the chamber is filled with air. It consists of a motor and two blowers, and is supplied with a case mounted on a stand and tripod. In field operation, there are only three pieces to carry: the case containing the instrument proper, the tripod, and a high pressure rubber hose—for connecting the instrument to the gas line. The total weight is approximately 35 pounds. This instrument is designed for spot readings of specific gravity, and can be used when gas at a pressure of 25 pounds or more is available as power to produce the rotation of the gas motor.

Low Pressure Flow Prover

Special effort has been made in the development of an accurate, simple means of determining the proof of displacement meters in the field, by way of avoiding the removal of meters to the shop for test. For many years, the funnel meter—which consisted of a multiplicity of orifices in the face of a funnel prover—was used to test proportional meters. Subsequently, this device was employed for testing large iron case meters in the field. In some instances, simple orifice meter installations were used for the same purpose. This led to the development of the low pressure flow prover.

The low pressure flow prover consists of two pieces of aluminum pipe, a set of straightening vanes in the upstream section of the pipe, special flanges equipped with hook bolts and thumb screws, together with several orifice discs for different rates of flow, a differential gage or U-gage, stop watch and thermometer. It weighs about 13 pounds, or, when furnished in a carrying case, approximately 38 pounds.

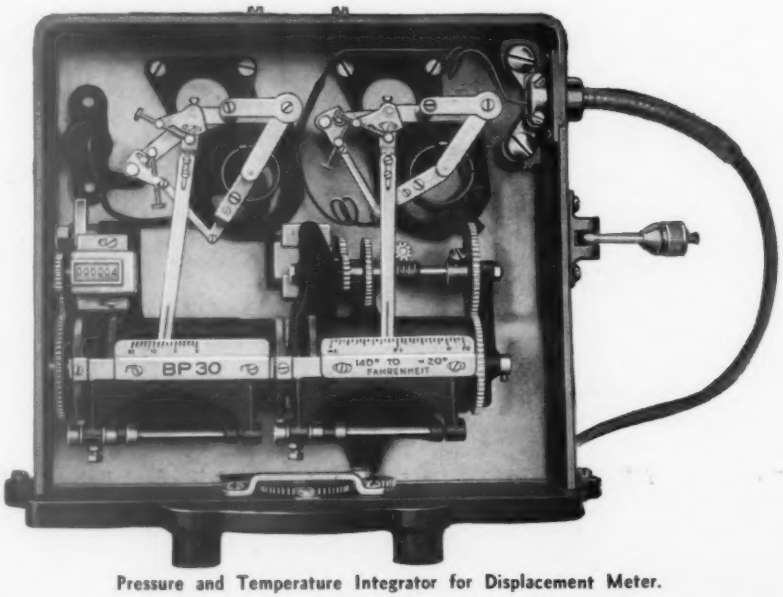
The advantages of the low pressure flow prover are that the orifices can be removed and kept in a place where they will not be damaged between tests, also that the differential reading may be any value that can be read with accuracy. In the case of the funnel meter, all tables were based upon the assumption that the maximum differential would be four inches of water when the specific gravity was 1.00, and the differential at other rates of flow would depend upon the specific gravity, temperature and the barometric pressure. So that, frequently the differential would not exceed 2½ inches, and any small variation in differential was likely to produce a considerable error in determination of the time. Furthermore, it was necessary to maintain a definite differential on the funnel prover. This was obtained by regulating the valve on the inlet of the meter, but a fine adjustment at this point was not always possible.

Special care has been given to the preparation of tables for the low pressure flow prover. Consequently, if the valve is set at a definite position and the differential is at any value between 5 and 10 inches for a gas of any specific gravity, an accurate reading can be obtained and small variations in differential will not produce an appreciable error.

Critical Flow Prover

The critical flow prover may be utilized for testing positive displacement meters at 15 pounds or more, by passing gas or air through the meter and the orifice and discharging into the atmosphere. If the proof of the meter does not change with changes in pressure—it should not—the time required for a full circle reading of the hand of the index would be the same for any particular orifice and any gas, regardless of the variations in pressure, so long as the same kind of gas were used. If the specific gravity, temperature or composition of the gas changes, the time for a definite volume will change. Different sizes of orifices are furnished for different rates of flow. For a test with any orifice, the gas time depends upon the size of the orifice, the ratio of specific heats of

(Continued on page 74)



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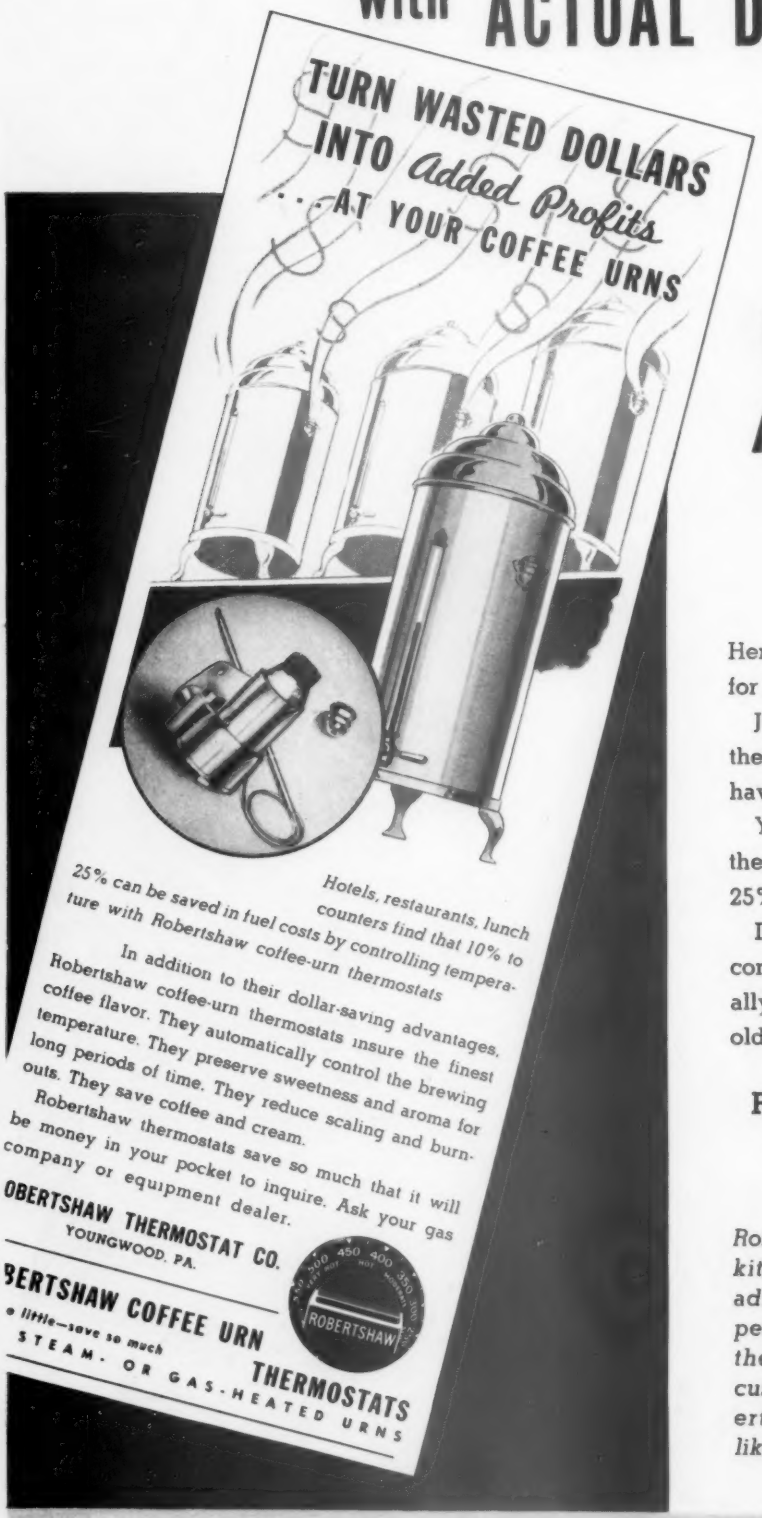
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Cost so little—save so much

Load Development on the Pacific Gas & Electric Company's System Since the Introduction of Natural Gas in 1929

By
F. F. Doyle
Manager of the Natural Gas Division
and
J. H. Gunz
Industrial Gas Engineer
Pacific Gas and Electric Co.

ON AUGUST 15, 1929, after a year and a half period devoted to study and construction work, natural gas first became available to San Francisco customers of the Pacific Gas and Electric Company. For another period of almost a year, the change-over from manufactured to natural gas of some 500,000 customers scattered throughout the northern part of California was carried on. During this time, too, additional construction work was done and natural gas made available to communities not previously served.

Transmission Systems

The first transmission line was constructed from the Kettleman Hills Oil Field, which is located about 200 miles south of San Francisco, extending north through flat desert country for approximately fifty miles, then over a section of the Coast Range Mountains to the Santa Clara Valley, a fertile agricultural area, to a point near San Jose. There the line divides, one line following the west side of the San Francisco Bay by way of Palo Alto to San Francisco, and the other the east side of the Bay to Oakland. This system also extends south for fifty miles from the Kettleman Hills field to the Buttonwillow dry gas field, which is approximately twenty-eight miles west of Bakersfield. This first line is known as the Bay Line and, in 1930, a second line was built north from Kettleman Hills along the west edge of the San Joaquin Valley through the towns of Tracy, Pittsburgh, and Martinez to San Pablo, a small town north of Oakland. The latter line was built jointly by the Pacific Gas and Electric Company and the Standard Oil Company of California, and is known as the Standard Pacific Gas Line. At a point fifteen miles south of Tracy on this line, a lateral was run north to the cities of Stockton and Sacramento. Both of these lines were run through or adjacent to several small communities which had not been served with any type of gas previously and which were, of course, later supplied from the new system. [See map elsewhere in this issue.—Ed.]

There is only one compresser station built and in use at the present time, which is located at Kettleman Hills. It compresses gas to 500 lbs./square inch, which is sufficient at the present time to take care of the entire load.

Problem of Revenue

In making the decision to make a capital investment amounting to many millions, a very definite problem was faced as to whether that investment would prove profitable. Decision was made to retain rates for natural gas at essentially the same level on a cubic-foot basis as those for manufactured gas. This obviously meant a large drop in revenue, gross as well as net, and to build sales to a point where the net income was satisfactory necessitated an expanded sales program. It was quite easy to determine just how revenues from existing customers would be affected and the extent of the reduction to them, due to the heating value of the natural gas being slightly over twice that of the manufactured gas. This estimated annual reduction in gross revenue was determined to be $8,500,000.00. Faced with this large decrease in revenue, several questions were put up to the sales organization to answer, or, rather, the sales organization was placed in the position of making good on the answers that had been given to the questions during the initial period during which the entire problem of natural gas was being studied. The questions were simple but, like many simple questions, not so easy to answer: (1) Where is new load to come from? (2) How can it be obtained? (3) How quickly can it be added to the lines?

Now, seven and one-half years after the first natural gas came into San Francisco, it should be interesting to review just what has happened during that time; the results that have been accomplished, and the steps gone through to reach that accomplishment. It should be borne in mind that natural gas was first introduced at the beginning of the depression and the progress that has been made was made in spite of unsatisfactory and distressing economic conditions.

Source of New Load

The question of where new load could be obtained was relatively easy to answer. The construction of the pipeline system made it possible to serve a number of communities previously without gas service, but nat-

urally these required additional capital expenditures for distribution systems so, although revenues received could not go far to make up the revenue lost from the business previously served, it did aid in carrying the pipeline capital.

Gas having been available to many of the larger communities for years, surveys indicate that the domestic cooking field was 87% saturated and the water heating field about 75% saturated. This left the domestic heating field as a large potential source of revenue. Intensive sales efforts carried on for years had gained a firm foothold for gas as a heating medium in the domestic field but, in spite of this, less than 21% of the central type furnaces used were gas fired. The problem here was very complex, not the least of the difficulties being that California is the Sunshine as well as the Golden State, and great numbers of the possible gas users firmly believed that an open fire-place was a splendid and adequate source of heat.

Closely associated with the possibility of the sale of gas for domestic heating were the possibilities of its use in the heating of apartment houses, hotels, office buildings, and similar institutions. This potential, while large, had the disadvantage of having a decided winter peak and also that it was relatively low-priced business.

Industrial Load Potential

Surveys indicated that a large potential lay in the field of industrial operations. The bulk of this potential was for applications in which the bare cost of the fuel being used was the factor receiving the major consideration. But the large volumes involved, together with the relatively small number of prospects, made this a most enticing field for consideration.

It is not the purpose of this article to dwell on results obtained insofar as net revenue is concerned, but rather that results be determined by the volume of gas sold. The fact that results have been satisfactory can be gauged by the fact that earnings have so improved that a rate reduction amounting to some $2,100,000 was made in 1936.

Experienced Selling Force

In 1929 the sales organization was composed of experienced salesmen, many having five or more years service with the company and under the direction of aggressive and able leaders. All told, the force consisted of some 104 men on the firing line actively engaged in the sale of gas for domestic uses. In addition to this, some twenty new men were active in the field selling to industrial and commercial prospects.

Being mindful of the fact that the unsold market in the domestic cooking field amounted to some 13% of the total, in the water heating field about 25% of the total, and in the heating field about 80%, it was decided to concentrate on the securing of the domestic heating business while, at the same time, maintaining aggressive work to increase the saturation of the cooking and water heating field.

Domestic Heating Problem

A practical problem was immediately encountered in that the utilization of gas for heating in a gas designed heating appliance of the central furnace type necessitated a very material investment on the part of the customer. Surveys indicated that there were in use many central furnaces using competitive fuel that were in excellent condition, which the users were reluctant to discard in favor of a gas designed furnace. Consideration was given to the possibility of converting these central furnaces to the use of gas by means of conversion burners, and steps were immediately taken to obtain some of the burners that were on the market.

It did not take a great deal of study or a long time to determine that the conversion burners available were entirely unsuited for Northern California's climatic condition. The degree days of heating required in Northern California approximate 3240 per year*, and an astonishing number of people seemed to have the idea that the degree days were nearer 1000 than 3,000, and had installed furnaces accordingly. It was found that the conversion burners available were generally far too large for use in the small central furnaces being used. Under this condition, the installation of a gas designed furnace was preferable to the installation of a conversion burner, but if all efforts were directed along this line, the volume of business that was desired quickly could not be obtained. So several simple and inexpensive conversion burners were designed and manufactured. These burners were priced at a low point, and an average price was assigned to the various sizes in order to facilitate handling and to reduce sales resistance. A specialty crew of 105 men was recruited and an intensive sales campaign undertaken to obtain the domestic heating business. The campaign began early in 1930 and an indication of its success is the fact that in the first nine months over 12,000 conversion burners were sold and installed. This campaign likewise had its effects on the new building which was going on; whereas, in 1929 only about 20% of the new construction specified gas for heating, in 1930 over 80% was so specified.

During the past seven years numerous campaigns were undertaken to stimulate the sales force to greater efforts and to promote dealer activity; likewise, during campaign periods, special inducements were offered prospects to install gas heating. Some of these offers consisted of extended terms, discount for installation during Summer months, and other similar features. Following the initial period when a tremendous volume of conversion burners was sold, the sales year by year have dropped off, although a total of 40,431 was reached by the end of 1936. On the other hand, the sales of gas designed central furnaces have increased more rapidly than sales of conversion burners have decreased and, in fact, number 47,568. As direct company sales of conversion burners lessened more and more, emphasis was placed on dealer selling.

Floor Furnaces and Circulating Heaters

Another heating device which is peculiar to California is the floor furnace. This is a heater which is set in the floor between floor joists, being vented to the outside of the building; it can heat from one to three rooms very satisfactorily, depending on its size and location. The heater is particularly adaptable for use in heating houses that do not have basements, which is a condition existing in a large majority of the smaller California homes. In the past seven years, some 46,581 such floor furnaces have been sold in the northern part of the State.

Still another heating device which reached a high degree of development during the past seven years is the circulating heater. This has been improved in design and afficiency so that today it is a very attractive heater and fills a real need in the heating field. Over 73,200 have been sold and installed in Northern California during the past seven years. All told, these various heating appliances, together with the smaller types, such as space heaters and gas radiators, have been sold in Pacific Gas and Electric Company territory

* *See Degree Day Map, American Gas Handbook, 1936, p. 164.—Ed.*

to the amazing total of 236,982 units. With the exception of the conversion burner, the bulk of this selling job was accomplished by the dealers active in the heating field. A further indication of the general acceptance of gas heating that has been developed during the past seven years is the fact that a survey of new building construction which has been going on for the past year indicates that 97% of all new residences are installing gas heating equipment.

Ranges and Water Heaters

During this same period, dealers have sold some 216,912 gas ranges, the bulk of which, of course, replaced worn out and obsolete gas equipment. However, the saturation of gas ranges, due to the replacement of competitive fuel, now exceeds 90% by a considerable margin. Even with this volume, it is evident that the number of units sold should be greater, as the indicated life of a gas range would be over 15 years if all sales were replacement sales. Obviously, ranges should be replaced more frequently than every 15 years. In the water heating market, 154,476 heaters have been sold and the saturation has likewise been increased to well over 90%.

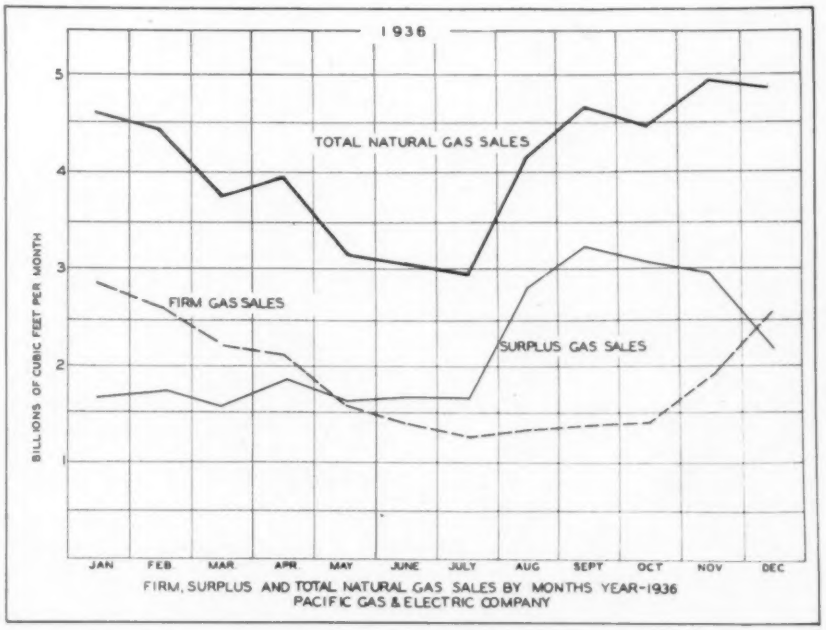
Total Units Reach Amazing Figures

The volume of gas units sold in the territory during the seven years number over 608,000 and represent a retail merchandise value of $37,296,000.00. To this must be added a material amount to cover installation costs. It can truly be said that any business that can gross in seven years through the depression over $37,000,000.00 is big business and the gas appliance business is certainly in that category.

During the seven-year period, in spite of the fact that a number of new communities were connected to the lines, the number of domestic customers being served actually decreased to a low in 1932. However, beginning with 1933, the trend again turned upward until today the number of domestic customers is 6½% greater than in 1929.

Gas Utilization in B.T.U. Shows 88½% Increase

Bearing in mind the relatively high saturation in the cooking and water heating field, it must be of interest to all to realize that these domestic customers have increased their utilization of gas in terms of B.T.U. over 88½% in 1936, as compared with 1929. This record goes only to January 1, 1937, and does not include the period covered by the severe cold weather experienced during the past winter. In fact, the degree days of heating required for the calendar year of 1936 were more than 11% below normal and, consequently, under normal conditions, the usage of gas would have materially exceeded the 88½% increase mentioned. In terms of cubic feet, the domestic customers used in 1929 slightly over sixteen billion cubic feet of manufactured gas and, in 1936, somewhat more than fourteen billion cubic feet of natural gas, having more than double the heating value per cubic foot of manufactured gas. Adjusting this volume for normal temperatures indicates that almost one billion cubic feet more would have been used except for the warm weather.



FIRM, SURPLUS AND TOTAL NATURAL GAS SALES BY MONTHS YEAR-1936
PACIFIC GAS & ELECTRIC COMPANY

Building and Hotel Heating

In the study made prior to natural gas being brought into the territory, as has been mentioned previously, consideration was given to the possibility of selling gas to apartment houses, hotels, and institutions of various kinds for their water heating and building heating requirements, this exclusive of any cooking needs which these prospects had. The major fuel used in these operations was oil, some of it Diesel and party heavy fuel oil. Indications were that the operations involved were such that a premium could be obtained for gas over the price paid for the competitive fuel being used. Naturally, the premium possible on a job using a large volume of fuel annually could not be as great in percentage as the premium possible for the user of a small quantity of fuel. The inherent advantages of gas have values which can be measured in dollars and cents in many instances, but, generally speaking, do not represent as large a percentage of the user's operation costs where the quantity of fuel required is large as compared to the user whose fuel use is small. Careful study indicated that gas could be sold at a price representing a premium about 40% over that of competitive fuels. As was the case in the domestic heating field, many factors had to be taken into consideration in the development of the sales program. The major problem encountered was that of determining the proper type equipment to be utilized.

As practically all the prospects were using competitive fuels, it became necessary to sell burners which could be utilized for firing the heating equipment. Dealers were urged to become active in this field, and, in order to assure adequate and proper installations being made, standard specifications were prepared outlining the general conditions and types of equipment which were necessary to assure satisfactory operation. In addition to this, a testing service was provided to make certain that the burner equipment installed was properly adjusted to obtain the highest efficiency possible. Generous selling offers were likewise developed, making it easy for the prospects to purchase and, for an initial period, a trial installation offer was made available in order to secure demonstration installations. This, together with a trained sales force of some twenty men, produced real results.

Gains Since 1930

Sales work did not begin until late in 1930, but business has consistently been added to the line since that time. At the end of 1936, almost 4000 accounts were on the lines and their usage for the year exceeded four billion cubic feet of natural gas, or over 60% as much load as was added by over one hundred times as many domestic customers. As this is all new business and of a type which has not previously been served, it is a definitely measurable achievement and one of which any organization could be justly proud.

For many years while manufactured gas was available, intensive sales work was carried on to increase the use of gas by industry and commercial customers, such as hotels and restaurants. A trained technical sales force actively solicited this load and, when natural gas became available, there was no let-up in the sales effort. Equipment dealers were enlisted in the work and aided in very possible way. Generally speaking, the natural gas sold for these purposes commanded a premium of from 50 to 150% over the cost of competitive fuels. These are operations in which the cleanliness and convenience of gas, together with all its other fine advantages, were utilized to the utmost in making sales. In some instances, customer inducements in the form of trade-in allowances were made but, generally speaking, extended terms enabling the customers to purchase equipment over a long period of time were all that were employed, aside from energetic and aggressive sales efforts to obtain the business.

In the seven years the number of customers in this classification increased 11%, while the annual fuel usage of the entire classification has increased 74%, or just under two billion cubic feet of natural gas.

Engineering Service

As was outlined in the case of the commercial building heating activity, trial installations were made and an engineering advisory service, together with a test service, were made available to customers to assure them of receiving the maximum benefits for the money they were spending for gas fuel.

Studies and surveys made, preliminary to the bringing of natural gas to the territory, indicated that fuel was being used in the territory by industry for major heating operations equivalent to about twenty-seven billion cubic feet of gas annually. With such an enormous potential to work on, careful studies were undertaken and plans developed to assure success.

Trained Sales Force

One of the first things that was planned was the education of the sales force to actively solicit prospective business. Several experienced engineers were also employed to act in advisory capacity to the regular sales force, whose job it was to solicit business. It was determined that, to be successful, the sales proposals made had to contain definite propositions to the prospect as to the cost of converting to gas and, likewise, recommendations as to specific equipment. For this reason, two definite types of burners were selected to be sold by the sales force, and, for the first year, practically every job installed was installed with one or the other of the two types of equipment. Efficiency testing service was also furnished to make certain that the equipment was adjusted to the highest possible point of efficiency.

With about two hundred jobs in successful operation, dealers in burners were encouraged to continue and expand their efforts to sell equipment to this type of prospect. Having set a high standard of installation, it was relatively easy to assure the continuance of good installations being made.

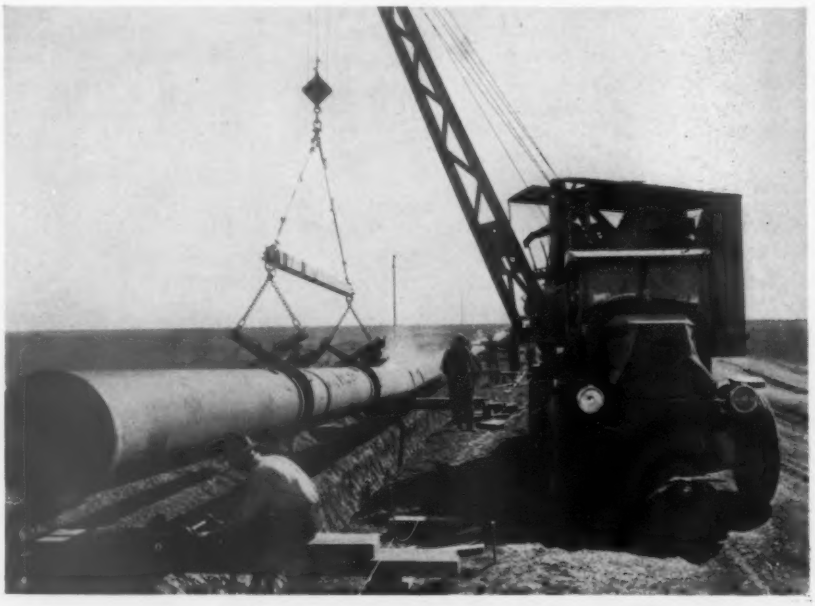
Special "Surplus Gas" Rates

All of this business was signed on three-year contracts and required that the purchaser would use gas exclusively as a fuel when it was available. The gas being sold was termed "surplus gas", meaning it was available for use by the purchaser only during such times as there was surplus capacity in the pipeline and distribution systems for delivering gas when it was not required for use by other customers paying higher rates. To compensate for this seeming uncertainty as to the fuel supply, the rates set up for the surplus gas were such that the purchaser could buy the gas at a price which would permit him to make savings sufficient to amortize his burner equipment in about two or three years' time. In many instances, the users of a large volume of fuel were able to amortize their equipment in a much shorter period than this, and in the case of the very small customers, in some instances it was possible that the cost of gas fuel actually represented a premium over the comparable cost of competitive fuel. As installations were made it was found that, generally speaking, the use of gas resulted in a fuel economy equivalent to about 10% of the gross amount of fuel used prior to the installation of gas. Time also demonstrated that very definite savings were made through the lessening cost of maintenance of fire boxes and equipment, and also because it made available for other work certain personnel that had been required to operate competitive fuel firing equipment.

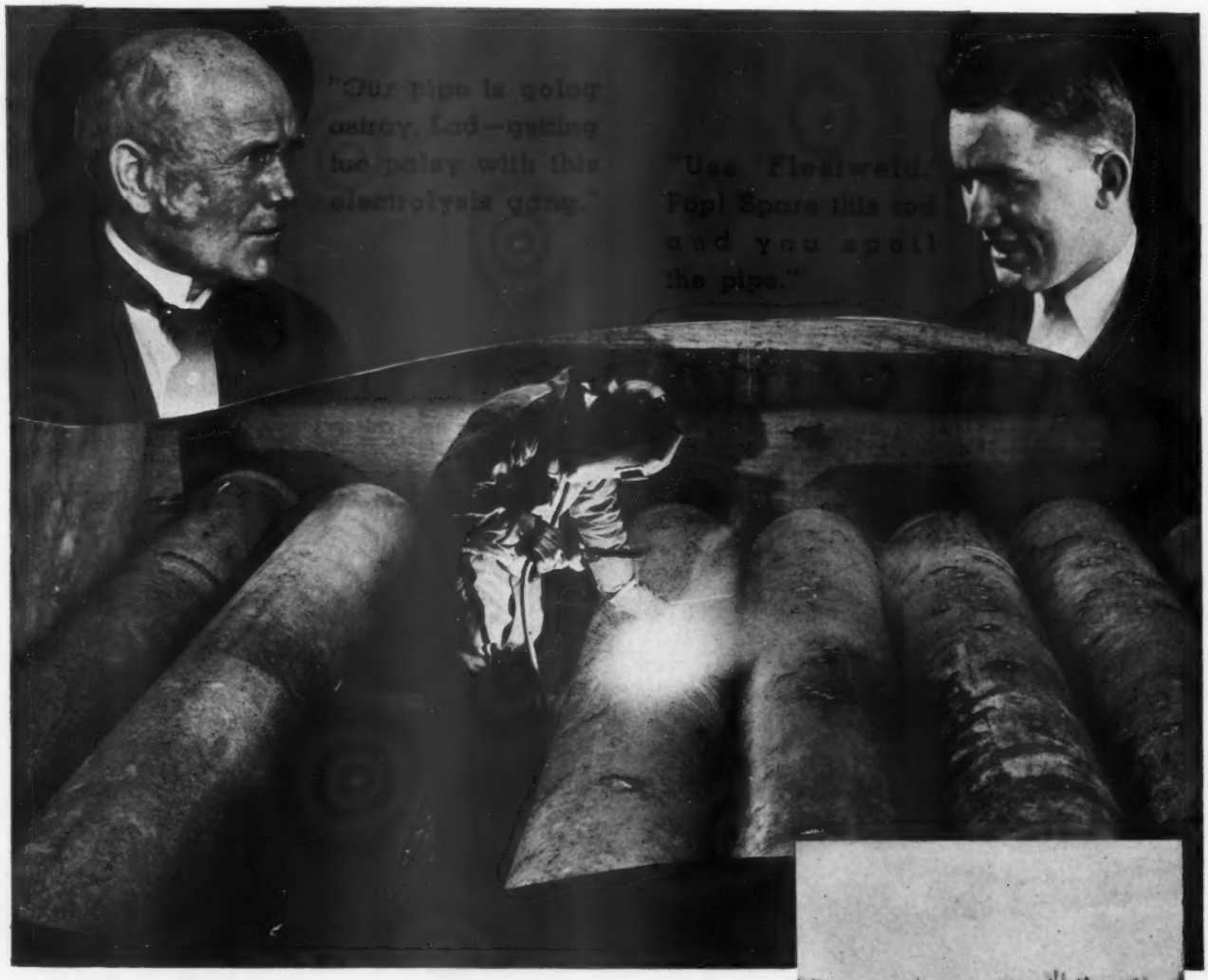
Oil Competition

After the sales campaign was under way about two years, a serious competitive situation arose through price cutting on the part of com-

(Continued on page 43)



Laying Part of Main Transmission Line from Kettleman Hills.



"I'm glad you mentioned your trouble, Pop. Really, there's no reason for letting your pipe go to the dogs because of electrolysis or corrosion.— Not when you can overhaul it by these simple plans.

"Plan one: Remove the pitted pipe. Clean its surface so that the pits can be detected. Fill up those defects by means of a '*Shield-Arc*' welder, using 'Fleetweld' mild steel electrodes. Test the pipe under air pressure with soap suds to make sure you've caught every leak. The reclaimed pipe is practically as good as new.

"You can recondition pipe this '*Shield-Arc*' way without preheating, saving more than 75% of the cost of new pipe.

"Plan two: Do like many pipe line companies. With '*Shield-Arc*,' they reclaim pitted pipe without interruption to service. That's working under pressure with ease.

"Get the Lincoln Welding Guide and learn other ways to put wayward profits back in the fold for keeps."

Pitted lines are often reclaimed by "Shield-Arc" *welding with pumping pressure "on."*

LARGEST MANUFACTURERS OF ARC WELDING EQUIPMENT IN THE WORLD

LINCOLN

THE LINCOLN ELECTRIC CO.,
Dept. AK-366, Cleveland, Ohio

Send a free copy of the Supplies Bulletin giving procedures for welding of various metals.

Name _____ Position _____

Company _____

Address _____

City _____ State _____

More Power FOR YOU IN

1

MIRACLE OF SILENT FREEZING

BRINGS OWNERS BIG SAVINGS

All over the world **SERVEL ELECTROLUX** *is providing safe refrigeration ...for more years at low cost...because its freezing system*

HAS NO MOVING PARTS

Here's the secret of this different, noise-free operation, which offers you exclusive advantages

3

Movie Stars and Savages Attracted to the Flame that Freezes

What Happens When A Hollywood Sophisticate Or A Wild Borneo Native Discovers Ice Being Made From Heat, And How They React To This Amazing Method Of Producing Cold Without Machinery Or Moving Parts.

2

Silent for all time

SERVEL ELECTROLUX
IS SILENT AND DIFFERENT
because its freezing system has no moving parts!

It gives you longer, more satisfying service and money-savings

All automatic refrigerators (and gents, much alike But your own ears will tell you that Servel Electrolux is basically unlike any other. It operates without even making a noise!

And this is a tremendous advantage in itself! But even more important is the cause of this permanent silence — a different, simpler way of producing cold and cubes of ice, which saves you money year after year.

Servel Electrolux has no moving parts in its entire freezing system — nothing need wear out. A tiny gas flame circulates the refrigerant — without friction or wear, without loss of efficiency due to moving, wearing parts.

As a result, you enjoy many years of perfect, trouble-free refrigeration with a Servel Electrolux. And you enjoy, as well, an amazingly low operating cost throughout its long life — a practical absence of upkeep expense and depreciation.

Concealed economies in food bills and leftovers. Owners find that Servel Electrolux saves enough to pay for itself in a remarkable, short time.

Today, in all parts of America, even the earliest Servel Electrolux models — models which are now from 1 to 10 years old — are still serving faithfully.

are still providing the same dependable, low-cost refrigeration as they did when new. They offer constant proof of the lasting benefits of refrigeration without moving parts.

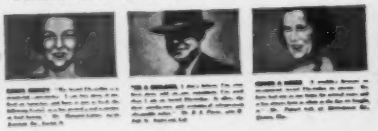
See the beautiful 1937 models at your gas company or local dealer's showroom. Get all the facts about this modern refrigerator that millions enjoy. Discover how easy it is to own one on a convenient purchase plan. Remember, Servel Electrolux has been tested and endorsed by the great American gas industry. Your own gas company offers prompt, willing service on every one it installs.

For farm and country homes it runs on kerosene or bottled gas

All the advantages and savings that Servel Electrolux brings to city homes can be yours on matter how far you live from the gas mains. Write for details to Servel, Inc., Evansville, Ind. Servel Electrolux is also sold in Canada, and in Central and South America.

* * *

TUNE IN "THE MARCH OF TIME"—Columbia Network—Thursday evenings, 10:30 P.M., E.S.T. Sponsored by the makers of Servel Electrolux Refrigerators



SERVEL ELECTROLUX
THE Gas REFRIGERATOR

N YOUR SPRING SALES DRIVE

HERE ARE THE LATEST ADVERTISEMENTS IN THE GREAT 3-WAY SERVEL ELECTROLUX CAMPAIGN. THEY'RE TELLING YOUR CUSTOMERS . . . SELLING YOUR CUSTOMERS . . . *THE ADVANTAGES OF GAS AND GAS REFRIGERATION*

THE BIG SELLING SEASON IS ON. Servel Electrolux' advertising program—the largest ever run on *any* gas appliance—is in full swing, blanketing your territory with hard-hitting sales messages. More than 23,000,000 people a month are reading about gas refrigeration! Other millions are hearing about Servel Electrolux through radio's greatest dramatic show—"The March of Time."

Are you making the most of this powerful promotion?

Have you organized for an intensive drive on your entire community?

Here are some fundamental steps that will help you build record-breaking business during the current A. G. A. campaign:

(1) Display new Servel Electrolux models prominently in your windows and on the floor of your showroom,
(2) Send out literature about this different refrigerator,
(3) Tie in with Servel Electrolux' magazine campaigns by advertising in your local papers,
(4) Put up poster displays on your local highways, and
(5) Utilize the backs of gas bills for "reminder" advertisements.

REMEMBER—Servel Electrolux sales mean *permanent benefit!* This modern, popular refrigerator not only adds to the total gas load. It also creates valuable goodwill and, by giving a daily demonstration of the efficiency of gas and gas service, helps to promote the sale of many other appliances.

Servel, Inc., Servel Electrolux Refrigerator Sales Division, Evansville, Indiana.

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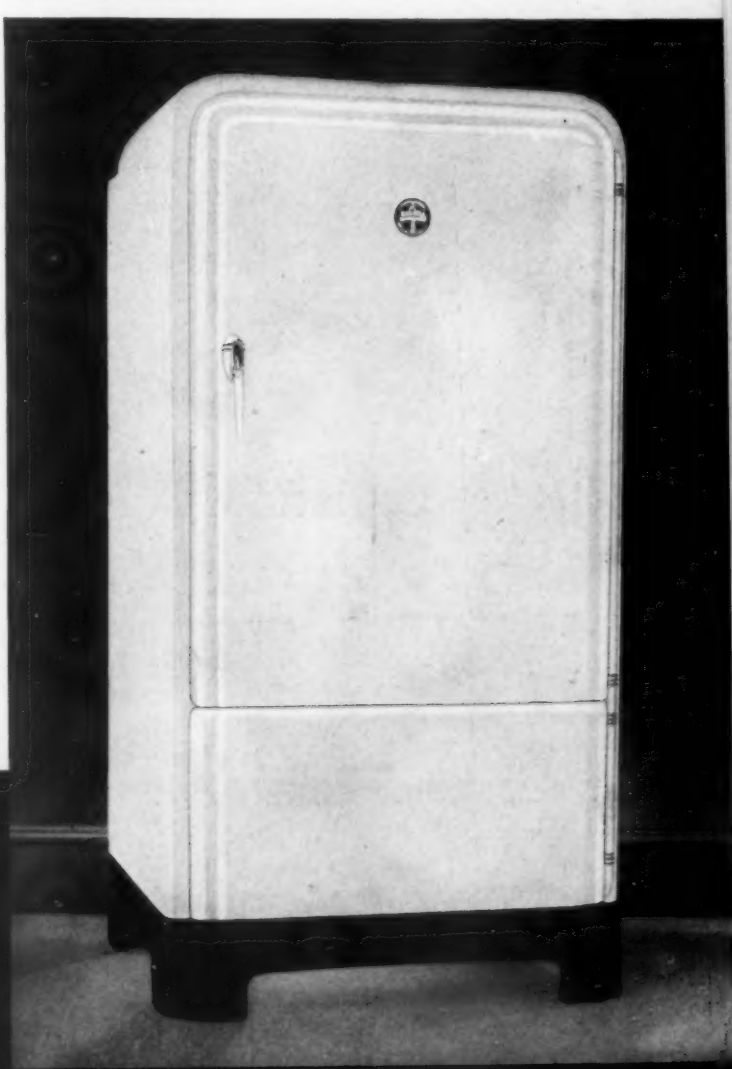
1 Here is another advertisement in the exciting tabloid series. Carrying the headline, **"MIRACLE OF SILENT FREEZING BRINGS OWNERS BIG SAVINGS,"** it contains many interesting pictures showing how Servel Electrolux is giving efficient service the world over. This advertisement will be run during May in "Collier's," "Liberty," "Good Housekeeping," "True Story," "American Magazine," "Better Homes and Gardens," and "American Home," with a total reader circulation of 13,458,679.

2 **"SILENT FOR ALL TIME"**—that's the headline for the May advertisement in Servel Electrolux' prestige campaign. This advertisement is running as a two-page spread in "The Saturday Evening Post" and a single page in "Time"—reaching 3,584,994 readers in all. A striking illustration combines with straightforward copy to tell an impressive story.

3 **"MOVIE STARS AND SAVAGES ATTRACTED TO THE FLAME THAT FREEZES."** With that arresting headline, the May advertisement in the "American Weekly" series continues its dramatic story of gas refrigeration. The top part of the advertisement drives home the essential difference of the Servel Electrolux refrigerator in an editorial manner. At the bottom of the page is a powerful, aggressive smash in color. This advertisement will reach more than 6,000,000 homes from coast to coast.



SERVEL ELECTROLUX

THE *Gas* REFRIGERATOR

The New NIAGARA Eighty

WINTER AIR-CONDITIONING UNIT

● The New Niagara "80 AC" represents the result of the effort of Niagara heating engineers to bring to owners of small homes the convenience, freedom, and cleanliness which emphasize the desirability of gas as a fuel.

The Niagara "80 AC" Winter Air Conditioning Unit presents an extremely compact assembly of heating elements, blower, filter, and humidifier, logically arranged in relationship to each other, and precisely regulated for smooth operation. The combustion chamber and radiating sections are of cast-iron. The blower is belt driven with adjustable pulley. The return air inlet is conveniently located in the rear, at floor level.

The cabinet of the Niagara "80 AC" has simple and symmetrical lines . . . permits ready access to all controls . . . completely envelopes the compact blower assembly . . . and uses a minimum amount of floor space. Its beauty is enhanced by a rich Chateau Green crinkle finish.

Those who occupy small homes may now realize the abundant degree of comfort, convenience, and economy which comes from using gas as a fuel, by having a Niagara "80 AC" Winter Air Conditioning Unit installed. Write for descriptive brochure.

THE FOREST CITY FOUNDRIES COMPANY

2500 WEST 27th STREET • • CLEVELAND, OHIO

(Continued from page 38)
panies selling oil but, in spite of this, the use of gas as a fuel by industry had gained such impetus that sales continued to be made and the business continued to grow.

In 1934, oil prices began to stiffen and, in 1935, actually increased, all of which emphasized the desirability of using gas as a fuel. A continuous record has been maintained of the estimated usage of the surplus customers as they were signed up from the beginning of this sales program, and it is interesting to note that the actual sales in 1936 amounted to 25,988,000,000 cubic feet, which is slightly more than the volume estimated. This close calculation was made possible because of the accurate information obtained from prospects as to their fuel requirements.

The unsold potential, it is estimated, amounts to approximately seven billion feet, which, together with that already on the line, represents a total somewhat in excess of that originally estimated seven years ago. This increase is due to the establishment of a considerable number of new industries in the territory, many of which began using gas as a fuel from the moment of their beginning operations. At the present time, 80% of all the fuel used by industry in the territory is natural gas.

Boiler Load Considerable

It is interesting to note that fully 85% of the customers served with gas under terms of the surplus contracts, make use of the gas as a boiler fuel. The other 15% of the customers represent a miscellaneous group of chemical plants, clay products manufacturers, glass plants, dehydrator operators, and some of heavy steel and iron fabricating and manufacturing plants. Of these customers having boilers, the largest group is represented by the laundry and cleaning and dyeing idustries, which compose about 25% of all the surplus customers on the line. On the other hand, the users of the largest volume of gas are the sugar beet factories, all of which are using gas as a fuel and, during the 120-day operating season from July to November in 1936, used a total of almost five billion cubic feet of gas.

Other Industrial Fields

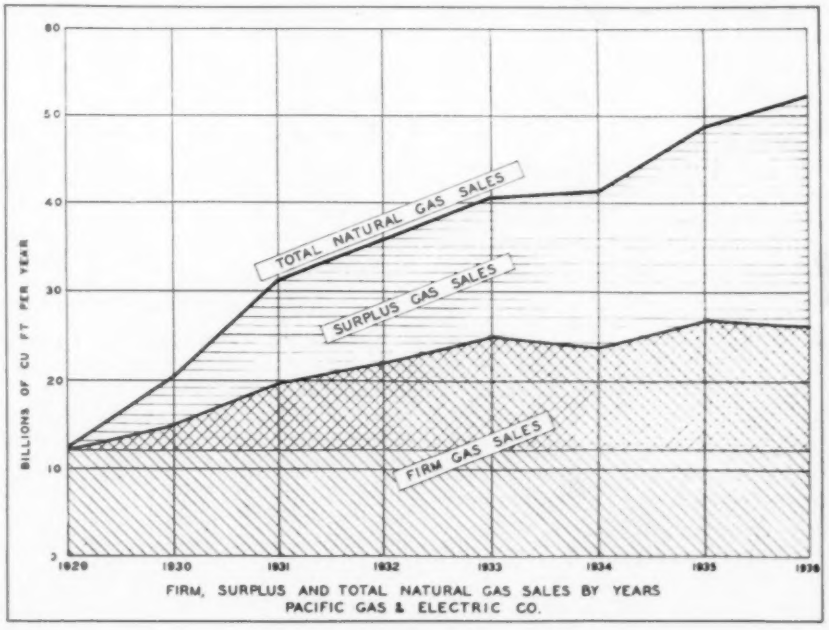
Another very desirable classification is the class composing the canneries, the operations of which occur largely during the Spring and Summer months, being shut down during the Winter season. This group composes 7% of the total number of surplus customers. Of a different nature, but likewise desirable, is the greenhouse classification, accounting for 5% of the customers. Although the usage occurs during the cold part of the year, the bulk of the usage occurs during the night hours when most other load is off the line. Hospitals and hotels, while relatively small in numbers, represent a good class of business, particularly as only those able to purchase over $4,200.00 worth of gas during the year are permitted to receive service under conditions of the surplus contract. The load is remarkably uniform throughout the year. Although there are at present only three glass plants on the line, yet this type of business forms the most desirable surplus load. The usage is constant throughout the twenty-four hours of the day and practically throughout the year, and the equipment is such that it can be readily converted to standby fuel.

Comment has been made to the effect that surplus gas is sold on a contract, indicating that the gas could be used only when a surplus supply was available. The purpose of this was that the use of gas by these customers could be curtailed to fulfill the demands of customers paying higher rates. Experience has demonstrated that the sale of surplus gas to plants having large boilers represents an ideal type of business, as there is little difficulty in changing to standby fuel. The sale of surplus gas to chemical and other plants utilizing fuel in miscellaneous industrial operations involves a hazard that curtailment cannot readily be affected, except possibly at the cost of loss of production and spoiled products for the customer.

At the end of 1929, the year that natural gas was first transported to Northern California, there were 27 surplus gas customers connected to the Pacific Gas and Electric Company's System. Each year since then, the number of this class of customers increased until at the end of last year there were 1050 being supplied with this class of service.

Effect of Increasing Load

When the transmission lines from the oil fields were completed there was, of course, transportation capacity in excess of the combined firm and surplus gas demands so that, under these conditions, it was not necessary to request surplus customers to switch temporarily to another type of fuel due to peak loads in the Winter months. The load increased each year as indicated on the chart accompanying this article, which shows the sales by years from 1929 to 1936, the total load reaching a point where it exceeded transmission capacity on peak days.



FIRM, SURPLUS AND TOTAL NATURAL GAS SALES BY YEARS
PACIFIC GAS & ELECTRIC CO.

It was not until January, 1934, that it was necessary to take off surplus customers and, at that time, only a small amount of this gas was curtailed for a short period, the largest users being taken off the lines; it was first found necessary to curtail surplus gas on a large scale the following year.

With the large number of such customers on the lines one can readily see the trouble that was encountered in attempting to discontinue the delivery of surplus gas in order to take care of the firm gas customers; that is, those on domestic and commercial rates. The problem which

confronted the Company was to see that all the surplus customers had suitable equipment and other fuel so that they could go off the line immediately when requested. It was necessary to contact all of them also to discuss with them the provisions of the contract to again attempt to make sure that they understood it.

Operation Under Division Managers

The Pacific Gas and Electric Company's organization serving the northern part of California is divided into twelve separate divisions, each headed by a Division Manager and each with an organization consisting of gas, electric, and sales departments, each division being almost equivalent to a small gas company in itself. The surplus customers on the Company's lines are located in all divisions so, therefore, are served from all parts of the system.

It was decided to have representatives of the sales department in each division contact the surplus customers in order to familiarize them with their contract and also to ascertain whether or not they were in a position to discontinue using surplus gas when requested. After having been on the line without curtailment for several years many individuals in customers' plants had forgotten the provisions of the contracts and often the personnel of the customer's organization had changed, so the operating force did not know that the gas being used was subject to shutoff. This work was done in the early Fall before the peak loads were expected to be on the lines and, at that time, the customers were notified of the possibility and almost certainty that they would be called upon during the coming Winter months to curtail the use of gas. This work had the desired effect as, during this past Winter period, less difficulty was experienced than ever before in getting the required amount of gas curtailed. Some of the customers preferred to take a chance and not provide standby equipment for fuel, preferring rather to discontinue their operations; such cases were very few, however.

Dispatching Department Duties

As in all companies serving natural gas which is transported through a pipeline system several hundred miles in length extending from the source of supply to the centers of population, the flow of the gas is controlled by a gas dispatching department, which studies load conditions at all times and anticipates the load from weather forecasts and other conditions affecting it. It is this department that determines each day the possible load for the following day and, knowing the capacity of the system at that particular time of the year, determines whether or not surplus should be shut off and, if so, what quantity.

In the gas dispatcher's office there is kept up to date a card record covering every surplus customer in each division, which record shows the approximate amount of gas used daily by each one. A duplicate record is kept in each division of the surplus customers in that division; only on the division cards a record is kept of the time each customer is requested to stop using gas and the time he is notified that he may resume the use of it. It would be impossible for the gas dispatcher's office to notify each customer who was to shut off the gas, so this work is taken care of by each division, the gas dispatcher notifying the division gas superintendent how much gas should be curtailed.

In the beginning a plan was set up whereby surplus gas customers would be shut off in accordance with the price paid or the quantity used, the larger users, of course, paying the lowest prices. It was found, however, that under this scheme it was possible that some surplus customers might never be requested to get off the lines during the season, especially if they were on the highest rates and used the smallest amounts. It was desired to make a plan that would be equitable to all such customers, which would prevent discrimination between any of them, and a plan that would treat all of them as much alike as possible.

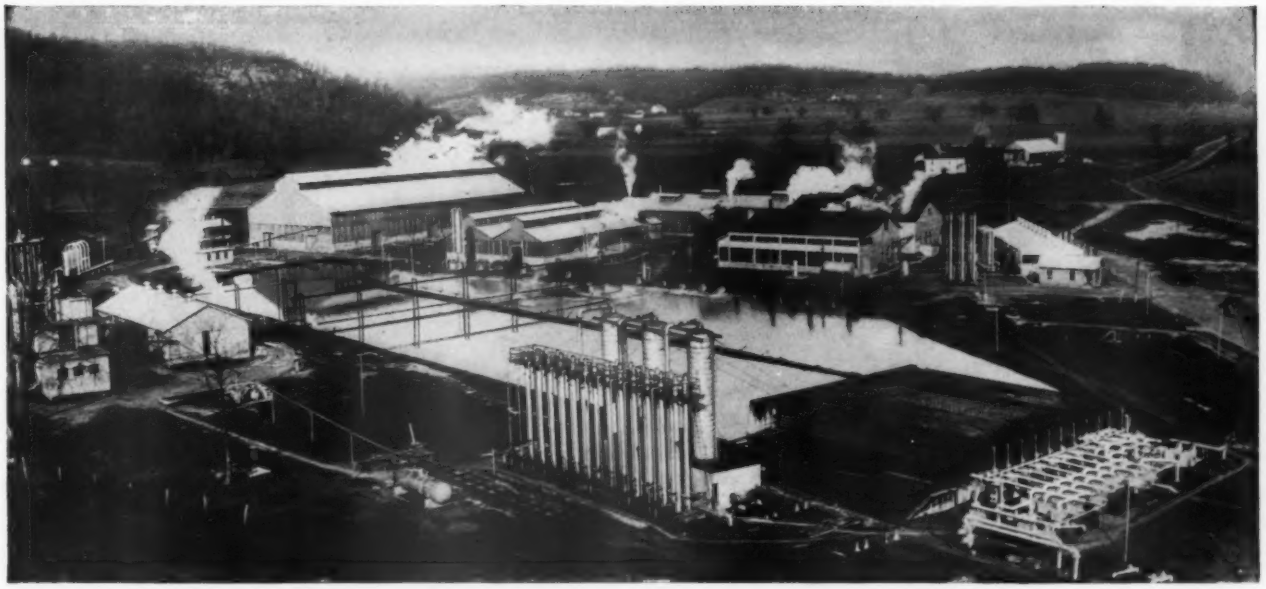
Customers Classified

Accordingly, all customers were divided into six groups lettered from "A" to "F", inclusive, the amount of gas used daily by the customers in each group amounting to one-sixth of the total load, which last Winter was approximately 11,000 Mcf. per day. In each group there were customers using the largest quantities down to those at the bottom of the list using very small amounts. There are, of course, customers in each group in each division of the company. Most of the times in the past when it has been necessary to curtail surplus gas, all have not been required to go off but only a portion. If, for example, it should be desired to curtail approximately 20,000 Mcf. per day, the dispatcher would notify all divisions to shut off surplus customers in groups "A" and "B". The period of the shut-off is generally for a few days and they are advised to have the customers go back on gas when the load conditions permit. The next time it is necessary to curtail gas and all of the surplus load is not necessary for firm use, groups "A" and "B" are allowed to stay on the line and groups "C" and "D" or more groups, if necessary, are called upon. Under this scheme last Winter all customers were called upon at least twice to stop using gas. Of course, at times of extreme load conditions, it is necessary to take all the groups off, which actually happened on two occasions.

Another important feature of the plan is that it makes each surplus customer realize that he is using gas subject to shut-off and should be prepared to change at any time. This is very essential not only for peak loads due to Winter conditions but, if there should be a serious pipeline break putting one of the transmission lines out of commission for a period of time long enough to seriously affect the supply of the firm customers, it would, of course, be absolutely necessary to have all such customers discontinue using gas, and this might occur at any time of the year.

High Efficiency Through Co-operation

Throughout the period natural gas has been served to the customers of the Pacific Gas and Electric Company, the gas department organization has spared no effort to keep the transmission and distribution lines operating at high efficiencies, and to maintain sufficient pressure at all times to serve the customers adequately. In this respect, cooperation, which is essential to the success of any business, has been the keynote. Considering the fact that natural gas was introduced to Northern California during a period of depression and trying times, the resultant record, achieved through the combined efforts and cooperation of both the sales department and the operating organization, has been very gratifying.



Crawford Compressor Station of the Ohio Fuel Company at Sugar Grove, Ohio . . . the largest in the world. It is one of 103 Columbia compressor stations with a combined capacity of 201,026 h.p.

MEETING THE GAS NEEDS OF A HIGHLY DIVERSIFIED MARKET

The service territory of Columbia System is a populous, intensely industrialized area in the states of Ohio, Indiana, Kentucky, West Virginia, Maryland, Pennsylvania and New York. To this large market, a dependable, economical supply of gas is made instantly and continuously available to satisfy the varied requirements of industry as well as for commercial and residential purposes.

At the end of 1936, operating companies of the System were serving directly 1,081,234 gas customers through more than 30,000 miles of gas pipe lines . . .

in 1,367 Communities with a total Population exceeding 5,000,000

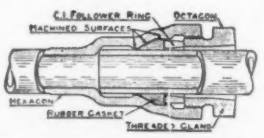
During the same year, gas sales of the System amounted to 134,371,800 mcf. It is expected, moreover, that this volume will increase as a normal consequence of business expansion, growth in population, ever widening use of time and labor saving gas appliances . . . factors in recovery which already are apparent.

COLUMBIA SYSTEM

COLUMBIA GAS & ELECTRIC CORPORATION

Bottle-Tight JOINTS

Here's the answer to corrosion and costly replacements . . . *cast iron* pipe that lasts a century . . . resists corrosion . . . reduces gas losses . . . all at *lowest* cost. Long 18 ft. lengths with stuffing-box type mechanical joints that stay *bottle-tight* under modern working pressures. A *permanent* installation that protects your rate structure, your revenues and your investment!



McWANE GLANTITE JOINT

placed at intervals in the line to provide maximum flexibility and to take care of expansion and contraction. The threaded joint, at left, oversize and extra strong is always the intermediate joint in factory assembled 18 ft. lengths of McWane 2" *cast iron* pipe.

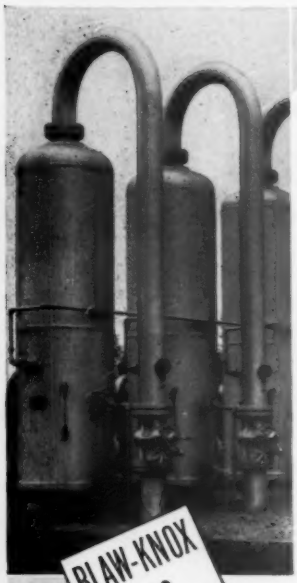
Sand Cast Inside and Outside

McWANE

CAST IRON PIPE COMPANY

BIRMINGHAM, ALA. SIZES 1¼" THROUGH 12"

Chicago, Dallas, Denver, Kansas City, New York, Portland, Ore., Salt Lake City, San Francisco, Los Angeles



A Good Way to Reduce COMPRESSOR MAINTENANCE EXPENSE

● Install Blaw-Knox Gas Cleaners to insure that gas going to the compressors is clean—free from foreign substances. This not only eliminates maintenance expense caused by dirty gas but insures continuity of operation.

BLAW-KNOX COMPANY
2070 Farmer's Bank Building, Pittsburgh, Pa.

BLAW-KNOX GAS CLEANERS

BLAW-KNOX GAS CLEANERS

BLAW-KNOX

Pipe Corrosion and Coatings

Survey by Observation

Part 11

By Erick Larson

THE factors causing corrosion and the methods of ascertaining the effects by both field and laboratory tests have been outlined. These tests indicate the rate of soil corrosion existing only during the short period consumed by the test. Variations exist between the predictions from such tests and practical pipe life, the causes of which may often be ascertained by careful observation of field conditions or from easily obtainable records. The numerical evaluation of these factors is seldom possible and their importance is a matter of judgment.

Climatological Effects—

Temperature

Temperature, wind and precipitation are three important climatological factors affecting corrosion. The tendency to bury mains with the least possible cover, will increase the importance of temperature as the seasonal differential increases with proximity to the ground surface. In warm climates, the average temperature is higher and, therefore, the rate of corrosion will be increased more than in cooler areas. The seasonal temperature differential is as much a function of the soil as of the heat zone. The heat conductivity of a soil will govern the rate of temperature change at all levels affected by surface temperatures. Although further research is needed to fully substantiate the statement, observations have indicated approximately the same temperature variations at equal depths in identical soils in all heat zones. The proof of this contention would explain some of the damage to pipe protection and even pipe itself.

Records of local soil temperature variations are usually available from state or federal agricultural bureaus. Water temperatures secured from a water utility may be used as another source of soil temperature variations but care is necessary when interpreting as they are affected by the depth of the water service or main and by the nearness to the source of supply or storage. Water mains are usually representative of a deeper soil strata than that occupied by gas mains. The following table is indicative of sub-surface temperatures.

Soil Temperatures—Clarksburg, W. Va. (1)

Year	Depth	12"	24"	36"	48"	60"	72"	Atmospheric Max. & Min.	Temp. Aver.
1923	High	74	72	69	68	66	64	97	53
	Low	32	35	36	39	44	46	0	
1924	High	70	70	68	66	65	64	96	50
	Low	33	34	34	36	40	41	3	
1925	High	74	72	68	68	67	65	101	53
	Low	33	36	37	37	40	42	8	

From a similar table the effect of temperature on the rate of corrosion at other times of the year than at the time of test may be estimated and if necessary an average approximated.

The general effects on the rate of corrosion of frozen soil surrounding a pipe has not been determined. The effect may be to exclude or minimize the quantity of oxygen reaching the metal thus lessening the rate of corrosion. The physical force exerted by the frozen ground upon the main, may remove from the surface of the pipe, products of corrosion which would ordinarily decrease the rate of corrosion during all periods of the year. The temporary decrease in corrosion rate resulting from the exclusion of oxygen depends for a total effect on the duration of the frost conditions but the decrease occurring during this period may be more than counteracted by the increased rate during the remainder of the year due to disturbance or removal of the products of corrosion which act as a natural protection. The effects of frost are greater on unwrapped than wrapped coatings. The nature of the damage will be explained under a discussion of coatings. When frozen, the soil temperature is dependent upon the depth attained by the frost, atmospheric temperatures, specific heat, conductivity of the particular soil, duration of atmospheric temperatures, etc., and, therefore, may be considerably below 32 degrees F.

Saturation

Comparative Rainfall (Inches per Month)
Winter 1930-1931 vs. Winter 1931-1932.

Month	Inches Rain	Month	Inches Rain
Dec. 1930	0.00	Dec. 1931	5.95
Jan. 1931	3.90	Jan. 1932	2.94
Feb. 1931	3.25	Feb. 1932	5.33
March 1931	0.00	March 1932	0.01
April 1931	3.02	April 1932	0.30
Total	10.17	Total	14.53

Comparison: Winter 1930-31 vs. Winter 1931-32.
December 15 to April 15, Incl.
Average of Average % Maximum Corrosiveness, 45 Locations

	Dec. 15 to April 15, incl. 1930-31		1931-32
Average of Average % Maximum Corrosiveness	53.6		60.3
% Increase in Corrosiveness 1931-32 over 1930-31		(12.5)	
Total Rainfall (inches)	10.17		14.53
% Increase in Rainfall 1931-32 over 1930-31		(43.6)	

Precipitation varies with the months and seasons of the year. From a knowledge of the variations in precipitation and the soil saturation determined at the time of making a test, an average saturation may be esti-

mated. The relationship between precipitation and saturation or rate of corrosion is not a direct proportion. There has been insufficient research to determine a general relationship but the method of approach to the problem is indicated in the tables just above by Corfield (5).

From the table it is evident that even large increases in precipitation will result in a considerable less percentage increase in the rate of corrosion.* Topography and geology may alter the relative differences in percentages in various sections.

An accelerated test may be conducted by assimilating precipitation through spraying water on a soil and after a sufficient time interval, measure the saturation. Duplicating a month's precipitation in a week would not produce accurate saturation results. The time element on this test would be of importance and must be determined locally. An accelerated test for the effect of precipitation on soil saturation is highly experimental.

Precipitation varies by years as well as seasons but the time consumed in extending a survey over more than a few months is impractical and when compared with the increased accuracy of corrosion rate prediction would not be warranted in most instances.

Visible moisture is not essential to rapid rates of corrosion as high humidities are practically as destructive. Soils of certain types may retain moisture so that the air in the voids is always at or near the saturation point, thus increasing the rate. Precipitation is not always the major factor as the power of the soil to retain moisture, the elevation of the pipe above ground waters, proximity to flowing streams, topography, geology, etc., may affect the moisture content of the soil or voids in a soil. The most rapid corrosion in general occurs in poorly drained soils.

Precipitation records may be obtained from the Weather Bureau of the Federal Government for practically every state. Such records represent conditions at the test station site. However the local bureaus may be able to furnish data or at least opinions as to variations of precipitation between each station. The records include snowfall in inches of equivalent rainfall. This factor must be considered as the snow in some sections may remain as such for the greater part of the winter causing an excessive continued soil saturation during the melting period. When possible, burial tests are desirable to determine the seasonal soil moisture content effects on corrosion. Otherwise the effect must be a matter of judgment.

Due to a lack of knowledge on the rate of corrosion during periods when the soil surrounding buried metal is completely frozen, advantage should be taken of every opportunity to make the necessary observations for determining the effect. This factor may have some significance when it is considered that in general the rate of corrosion appears to be more general in sections where the ground is never frozen.

Topography

Topography indirectly affects the rate of corrosion by altering the soil moisture content. Mountainous sections may have highly localized, comparatively dry or heavy rainfall areas due to the air currents directed by the contour of the ground and the proximity of clouds to the higher points of land. Areas receiving the maximum rainfall may usually be distinguished by a greater amount of erosion caused by the run-off of larger volumes of water. Such areas are important not only from the average soil moisture content possibly being greater than in surrounding areas but also the erosion may tend to expose a main to the direct action of the sun and atmospheric elements which may cause a more rapid deterioration than the soil.

In mountainous or hilly sections where the degree of slope is sufficient to limit the length of time some areas are exposed to direct action of the sun, such shaded portions would normally retain moisture for a longer period. Such a condition would affect the length of time and the penetration depth of frost, vegetation and bacteriological content of the soil.

The rapidity of run-off where the slopes are steep would ordinarily result in the soil having a less average moisture content than the same soil in flat sections while the shading of areas would increase the average moisture content.

The degree of slope is also of importance in the maintenance of a uniform soil mixture. In flat country the salts or the other ingredients of a soil may gradually be washed out or down to a greater depth. The periodic immersion of flood plains causes deposits whose source may vary and thus change a soil from a noncorrosive to a corrosion type. Where the slope is steep, the surface strata may not be as uniform as a flood plain but the products of rock weathering and erosion are carried to lower elevations and by being deposited in narrow bands may result in soils of rapidly varying rates of corrosion. This condition may be more common where the frequency of slope change is the greatest.

There is a general direction of drainage even with a frequent change of slope. The significance of the general direction is not usually of importance unless the run-off may be contaminated by some particularly destructive corrosive agent.

The effects of such topographical characteristics as lakes, ponds, waterways, swamps, marshes, etc., on the rates of corrosion are obvious and have already been mentioned when illustrating various phases of soil moisture content.

The inclusion of topography as a factor in corrosion clarifies many difficult situations where the lack of comparative results in rather small areas tends to cause confusion. The cause of corrosion is frequently external to the surveyed section and topography may be the necessary guide. Seeking logical broad reasons will often lead to more rapid analytical solutions. As an illustration, the bed of a former water course may appear dry but retain many a corrosion problem if vision does not reconstruct the original conditions of running water. Distribution systems frequently encounter former stream beds, the waters having been diverted to more convenient locations. The soils in these former water courses may be considerably less corrosive than that of adjoining similar soil types. The corrosive elements in the soil may have been washed out by the water. Again extreme corrosion may become apparent because of gas leakage at one particular location and a study to determine the location as a former water course and failure of the metal due to the material used in filling. Safety would then be enhanced by plotting the course of the previous water course and

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*(*For curve of corrosion rate vs. saturation see page 20, American Gas Journal, December 1936).*

1. *From "Ground Temperature Variations," page 129 of 1936 American Gas Catalog and Handbook.*
2. *From "A Comparison of Ground Temperatures at Different Depths and Temperatures Fluctuations of the Atmosphere," by E. L. Rawlins and T. W. Johnson of U. S. Dept. of Commerce, Bureau of Mines.*
3. *"Influence of Oil in Soil Corrosion," by Walter F. Rogers in Proceedings of Thirteenth Annual Meeting of the American Petroleum Institute, Nov., 1932.*
4. *"Cause of Corrosion in Alkali-Knoll Soils," by Walter F. Rogers in the Proceedings of the American Petroleum Institute, 11-15-34.*
5. *"Soil Moisture Survey Procedure and Summary of Results," Corfield, Wrestler and Terradell, 1933 Underground Corrosion Conference.*

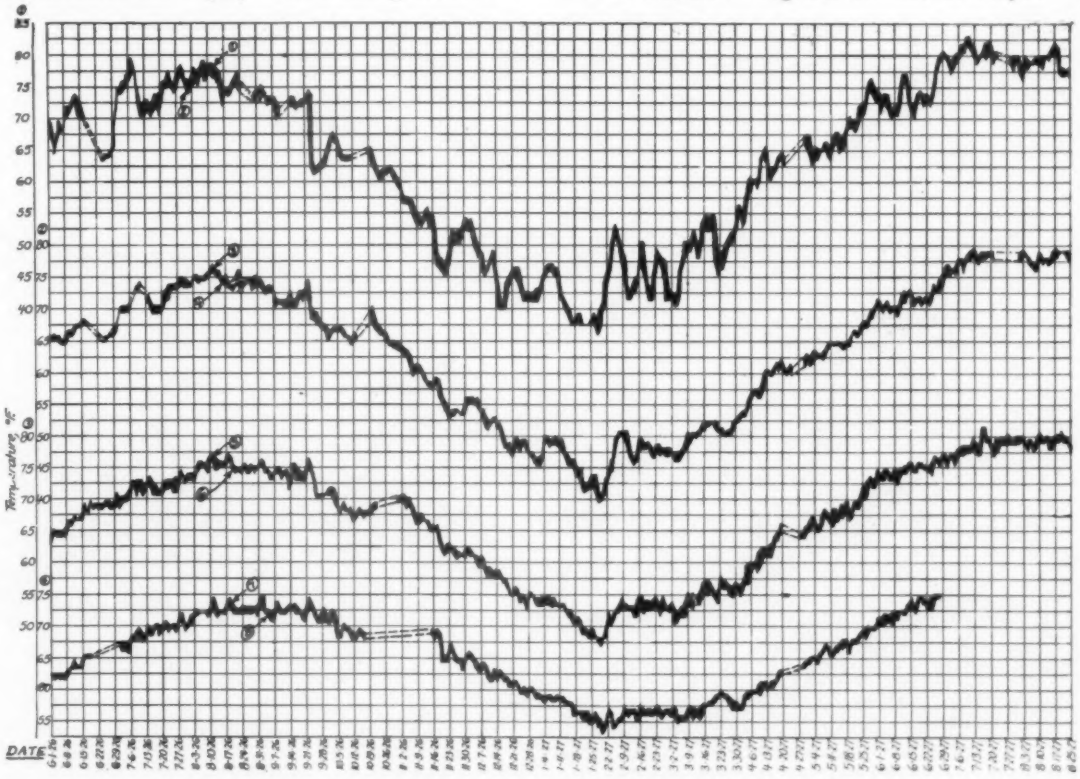
protecting the existing structures against the known rapidity of penetration and making ample provision for future structures.

Geology

Topography may assist in a visible selection of areas in which corrosion will be rapid although the soil itself and vegetation are important aides. Along the Gulf Coast, Rogers (4) reports that pipe lines passing through "alkali knoll" soils are subject to much more rapid corrosion than in adjacent clay or clay loam soils. These knolls are composed largely of sand and silt particles, the clay content being low or missing. The part, topography plays in the survey is that the alkali soil occurs in numerous low, small mounds usually from 10 to 20 feet in diameter and rising from 6 inches to two feet above the level of the surrounding ground. Having experienced the highly deteriorating action of the soil in these hummocks, their occurrence in new territory would suggest the desirability of detailed soil testing even though surface appearances were similar to the adjacent less corrosive soil.

Geology has not been identified so far in this description of corrosion as a specific factor affecting the rate of loss but many of its phases such as stratification, dip of various strata, depth of strata, characteristics of soil such as particle size, source, etc., all belonging to this general category. The method of soil surveying by outlining the soil type boundaries recognizes geology as an important factor in corrosion. A geological survey is recommended as one of the important initial field efforts but should be supplemented by more specific methods. As a preliminary step soil maps of a section may be secured from the Bureau of Agriculture. Such maps are made for agricultural purposes but frequently assist a surveyor to recognize various soils not previously encountered. As with beauty such maps may only be skin deep and the real corrosion characteristics must be ferreted out of lower strata. The scale of the Bureau's maps is small and therefore not ordinarily suitable for a distribution system survey. Only part of the country has been surveyed and that mostly in agricultural districts. An effective method of training corrosion specialists in soil description is to have them spend time checking Federal soil maps in agricultural districts and then outlining a district before seeing a prepared soil map. Agricultural Department agents are continuously mapping soils so where possible joining such a party for experience is more valuable than checking maps. Under certain conditions it is possible to secure direct assistance from the Bureau of Agriculture to map a district.

The Bureau of Agriculture has developed a standard set of symbols which is available by requesting their booklet.



DAILY TEMPERATURE VARIATIONS OF GROUND AT DIFFERENT DEPTHS (2)

1 and 2 Maximum and Minimum daily temperatures at depth of 1 foot; 3 and 4 at depth of 2 feet; 5 and 6 at depth of 3 feet; 7 and 8 at depth of 4 feet. Periods when daily observations were not obtained.

The difficulty with geologic corrosion surveys is a lack of records of quantity and reliability of statistical data and therefore its use in new territories is confined mainly to the suggestiveness of some features rather than direct prediction of soil corrosiveness. The cause of a lack of consistency in the corrosiveness of the same soil type in different localities may sometimes be found in the geological history of that type. The recording of such observations will be valuable in extending the usefulness of geological knowledge in predicting corrosiveness. The prediction of pipe life by comparison with metal lines existing in the same soil type at other locations is of more academic than practical importance at present although worthy of further study.

The geo-physical nature of the sub-strata may be such as to confine any liquids entering the soil to a surface strata. Depending on the soil moisture retaining properties, the result from such a geo-physical structure may be an average high saturation or due to the effect of atmospheric humidities the ground water may be rapidly evaporated. When rock is cut to provide a channel in which to lay pipe a natural water reservoir is created which may provide a continuously saturated soil.

Physical characteristics such as texture, density, compactness or compactibility, particle size, colloidal matter, porosity, etc., have already been mentioned. The movement of soil is a subject of vital importance the mechanics of which have not been thoroughly investigated. Movement may be caused by other phenomena than frost. The importance of movement is not confined to displacement of products of corrosion on bare metal but is vitally important in the success of applied protection. The existence of soil movement has made wrappers a necessity in practically all localities. The adhesion and cohesion of the soil particles plays an important role especially in the more finely divided soils such as clay particularly when the soil is subject to alternate wetting and drying.

Biological Survey

Vegetation, directly and indirectly affects both bare and protected metals. In a study of corrosion, an intimate knowledge of plants is not essential as the most vital factor is root depth. Surface roots do not ordinarily affect corrosion except by absorbing moisture or preventing evaporation from the soil. A large tree may give off as much as sixty-five gallons of water on a warm day practically all of which is secured from the soil surrounding the roots. While plant roots remove large quantities of water from the soil the larger ones, 1/16 inch in diameter or more, appear to have a moist surface even during the dry season. These moist roots have been frequently observed as the cause of deep bare steel main pitting. Complete penetration has occurred where the root followed the bare steel for a matter of a few inches whereas the remainder of the steel in the particularly observed instances still retained its original appearance except for a few areas of minor surface rusting. The roots were apparently from maple trees although many bushes existed in the immediate vicinity and exact determination was not possible due to severance of the root during excavation.

Tree roots are not the only ones which go deep in search of food and moisture. Damage to unwrapped pipe protection was traced and found to be caused by a root from the common goldenrod. Deep roots are not to be interpreted as only occurring when the tree or plant is of the so-called tap root type which has a single large root. A tap root is practically an extension of the trunk projecting deep into the soil. For instance elm trees usually have a thick surface matting of roots but many instances have been found where these roots send shoots two and three feet below the surface.

Following excavation of a trench, the loose soil in the backfill offers the least resistance to root growth. Particularly immediately adjacent to the pipe, conditions are excellent for root growth and after a year it is not uncommon to find a matting of hair roots attached to or touching a main. Fortunately the damage to bare metals by tree roots does not appear to be extensive but this observation should not be taken as specifically applying to any particular territory unless supported by thorough examination. Surrounding a main with material which is toxic to roots has the disadvantage of potential damage to the whole plant. Such toxic substances must be soluble and therefore will gradually be scrubbed out of the soil. The more important damage to protection caused by roots will be discussed later.

The indirect effects of vegetation are factors in corrosion. The decay of vegetation frequently adds to the corrosiveness of a soil by increasing the relative amount of corrosively active constituents, such as vegetable organisms and organic acids. Where plant life is abundant, mains are not ordinarily buried in the top strata where decay is most rapid but some of the resulting corrosive elements pollute waters which eventually reach structures buried in the lower strata. In the course of time the concentration of corrosive agents in the lower strata may increase and may account for the progressively increasing rate of corrosion with depth up to a certain distance below the surface. Thus a knowledge of biological conditions may indicate the cause of soil corrosiveness.

Vegetation may frequently be used as an indicator of soil type boundaries. An extreme case would be the entire lack of vegetation except possibly some grasses and reeds in any area where high concentrations of salt exist, such as in areas near tide waters. Placing a layer of top soil on salt water marsh has resulted in an ability to grow a few plants but their frequently unhealthy appearance and stunted size is indicative of the influence exerted by underlying conditions. Extensive

Oil Pipe Corroded Adjacent to Collar.

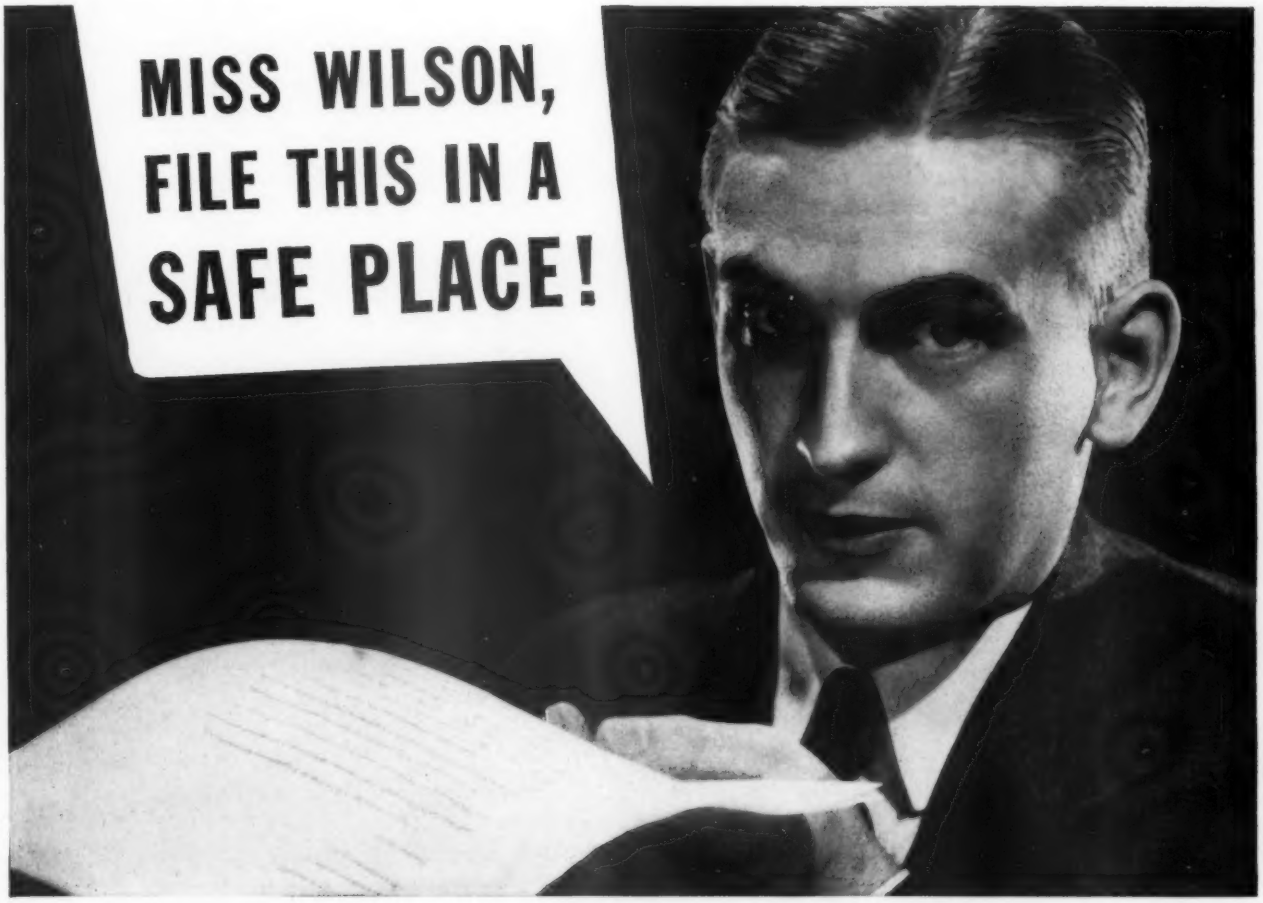
areas of dwarfed vegetation may indicate a general lack of plant food in the soil and thus a lack of many salts which would increase the rate of corrosion may be assumed. Although this assumption should be checked, areas of stunted plant life are generally not highly corrosive. On the other hand areas almost or entirely devoid of vegetation may have such high concentrations of various chemicals as to be toxic to plant life and may also be highly corrosive.

In city conditions a lack of plant life is ordinarily caused by a lack of proper food rather than a lack of moisture. The paving of streets so as to leave only a small open space around trees does not always result in lack of moisture beneath such impervious surfaces as corrosion surveys have indicated a higher per cent of moisture content below such surfaces than in the same soil in exposed places.

The myriads of micro-organisms existing in as yet unknown quantities in the soil may be of more vital importance than hitherto realized. Anaerobic organisms which can exist as the name suggests in an absence of oxygen, possess the ability to chemically change otherwise stable soil constituents and produce compounds which will affect the rates of corrosion. Aerobes, the air-requiring relatives of the anaerobes, also possess

(Continued on page 91)

MISS WILSON, FILE THIS IN A SAFE PLACE!



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GOODMAN — USED SINCE 1897 — 2" HANDLE & LOCKING SLEEVE — GAS MAIN STOPPER

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GOODMAN-PEDEN STOPPER

In the Goodman-Peden Stopper the flexible frame, padding, covering and diaphragm of Goodman Stopper remain in principle, but the handles have been discarded and in their stead a new arrangement in construction makes it possible to operate the stopper mechanically rather than by the experience and skill of the workman. Made in standard sizes.

Patented

New England Representative
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STOPPERS SINCE 1897

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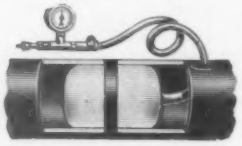
PLAIN RUBBER

Made in four types

Very Light	Type AA
Light	Type A
Medium	Type B
Heavy	Type D
Canvas Covered	Type C

CANVAS COVERED



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For use on cast iron or steel, oversize or undersize mains.

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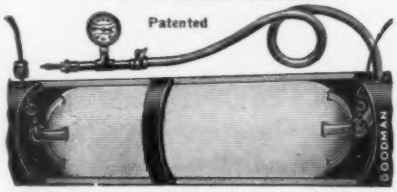

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C. B. BABCOCK CO.
475 Eleventh Street
San Francisco, California

Diaphragm Meters—Operation And Design

Part 1.

by

Allen D. MacLean,

Chief Engineer
Pittsburgh Equitable Meter Company

WE have a number of peculiar paradoxes in the gas industry. In the first place, we sell something which we can't see, yet get good money for it. We call it a gas and as such we hoard it, store it and distribute it very carefully, but we take, without paying or regard, a much larger volume of another gas from the atmosphere (oxygen) to produce any utility from our product. In some cases the gas has a malodorous smell, about which there is considerable complaint; yet in other cases we must purposely add a smell by means of an odorant to make people complain of its presence. But perhaps the most peculiar paradox of all is the fact that what we really offer as its sole value is heat (which we express in B.t.u.'s), perform most of our calculations concerning it in weight units (in grams or pounds), but express our final measurements in volume (cubic feet). We are somewhat in the position of the man who likes oranges, because they taste more like prunes than bananas do.

Of course there is a good reason for using volume as our almost universal means of measurement in gas. We might better use weight, since in burning one pound of gas of a given chemical composition, a very definite number of B.t.u.'s is produced, whereas a cubic foot of gas must be defined accurately as to pressure and temperature before we can predict how much heat is available. However, it is exceedingly difficult from the point of view of physics to measure the rather small quantities of weight consumed by an average domestic consumer, particularly as the gas is flowing. So we say our pressure is very nearly constant, and our temperature doesn't vary too much, and we might as well use volume to express our measurements, particularly since we haven't been clever enough to devise any simple way of weighing our gas as it flows on to the consumers' premises. So in gas measurement, particularly in domestic meters, measurement by volume is the most practical method.

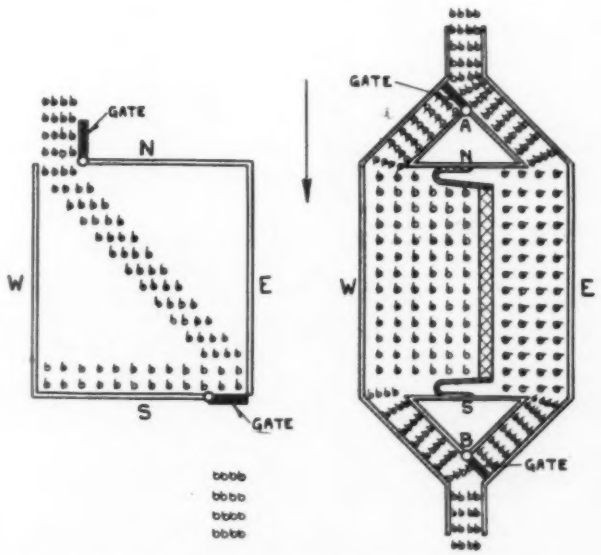


Fig. 1. Xerxes Stockade and the Principle of the Gas Meter.

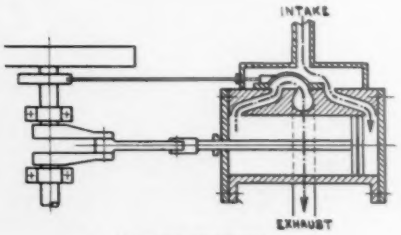
Perhaps the nearest approach to a measurement engineer that we find in early history was the Persian General Xerxes, for he just barely missed developing the principle of a positive displacement gas meter. He was faced with the task of counting the number of his vast army as it was on the march. He built a stockade along the line of march such as shown at the left of Fig. I and allowed his soldiers to march into it until it was full. By actual count, he knew the number of troops required to fill it once, and by filling and emptying, filling and emptying as his army marched through, and counting the number of times it was filled, he could obtain the number of his troops.

We notice, however, that there is lost time while the stockade is being emptied. Too bad he wasn't forced to conserve his time, for he no doubt would have worked out the method of counting shown at the right of Figure I, and earned for himself the title of measurement engineer in addition to that of a great soldier.

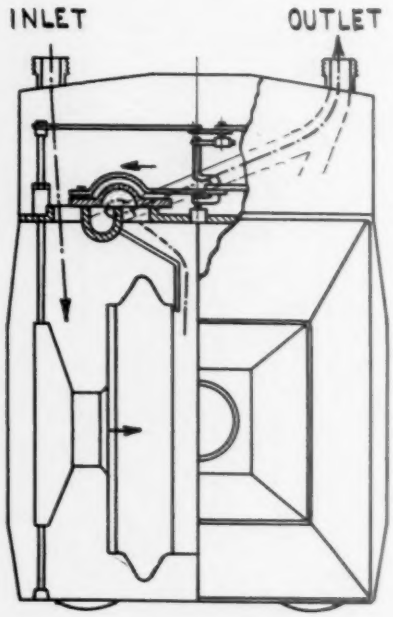
At the right of Figure I, we notice the same stockade, but this time the arrangement of inlet and outlet gates are slightly different, and we have provided a bar, about as long as the stockade, attached to the middle points of the north and south walls by ropes. We station a general at gate A and another at gate B, and when the army approaches, gate A is swung so the troops march in to the east side and pick up the bar, carrying toward the west wall. The space between the bar and the east wall rapidly fills with troops until the bar reaches the west wall and the stockade is filled. At this moment general A swings his gate and troops now can march in the west side entrance; General B simultaneously swings his gate so that troops can exit from the east exit gate, and these troops already in the stockade march out this east gate. The front line of troops coming in the west

gate pick up the bar, march toward the east wall just as fast as the other troops evacuate. When the bar reaches the east wall Generals A and B again swing their gates and the movement is repeated with a new complement of troops marching in the east entrance gate. Just count the number of times the gate is swung, multiply by the number of troops required to fill the stockade, and the strength of the army is determined. For each soldier substitute a molecule of gas, for the bar and ropes the diaphragm of a meter, for the gates the valve mechanism, and we have a gas meter.

The need for the first gas meter occurred of course many centuries after Xerxes' day, in fact at the time when the reciprocating steam engine



STEAM ENGINE



TIN GAS METER

Fig. II. Steam Engine Analogy of the Gas Meter.

had just been developed and no doubt Bogardus, Clegg, Berry, Croll, Richards and Glover, to whom early gas meter development is attributed, were influenced, particularly in valve movement design, by the early reciprocating steam engine. In Figure II we see the analogy between the steam engine and the diaphragm type gas meter. For a piston in a cylinder we substitute a diaphragm disc and diaphragm, moving in a case which approximates the cylinder. The valve movement of the meter is almost identical with that of the steam engine and there has been but little change in its operation since the earlier meters. By studying the motion we can see that the valve admits gas from the inlet to one diaphragm compartment during the diaphragm movement, and through the D section of the valve allows gas to pass to the outlet simultaneously from the oposite valve compartment. This relation calls for the valve to have a very definite position for every position of the diaphragm. We will see later that the relative position of the valve with respect to the diaghragm is very important and affects the accuracy of the meter.

Anyone who has had experience in operating a reciprocating type steam engine is familiar with the habit such an engine has of coming to rest when intentionally stopped with the piston at the end of its stroke, and the D valve exactly at the center covering the valve ports. If steam is again turned on, since both ports are covered, the engine will not start until it is turned over by hand. Since the same valve construction is used in a gas meter, the same sorry spectacle of the meter failing to start is possible under certain conditions, thereby cutting off the gas supply. Such a possibility is usually avoided by building the gas meter so that it includes two steam engines, i.e., two diaphragms, connected together in their action so that if one is at its "dead center position" the other must be at a position where the valve is wide open. This prevents the possibility of the meter stopping and failing to start when the gas is turned on.

It might be well at this point to refresh our memories on the actual detail operation of the simple two-diaphragm gas meter. In Figure III is shown four positions of the meter in operation. With the meter not operating, the pressure will equalize throughout all compartments, and will be the same on both the inlet and outlet. In A, of Figure III, we see that the left or case compartment of the left diaphragm is connected through the D section of its valve to the outlet. The right, or diaphragm compartment of this same diaphragm, is connected to the inlet. In the right diaphragm we see that the diaphragm is at the end of its stroke and the ports to both the case and

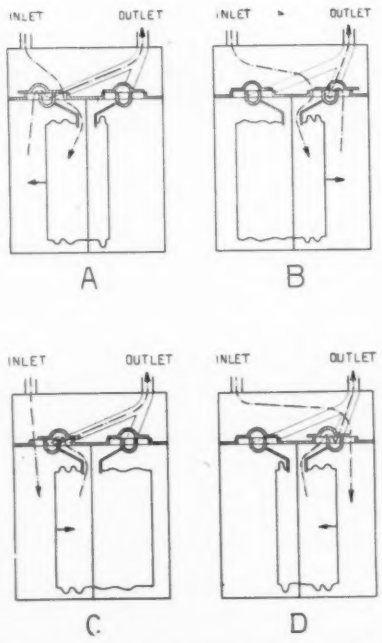


Fig III. Relative Diaphragm and Valve Position in a Diaphragm Type Gas Meter.

diaghragm compartments are closed by the valve. When the cock on any appliance connected to the outlet of the meter is opened, the pressure on the outlet line will immediately start to decrease, and decrease the pressure in the case compartment of the left diaphragm. The pressure on the opposite side of this diaphragm remains at the inlet pressure valve, therefore, due to unbalance of pressure, the left diaphragm will start to move to the left forcing its case port gas into the outlet pipe. The right diaphragm, being connected to the left diaphragm through the crank mechanism, will also move and in a short while the meter will be in position B. When the left diaphragm is at its stroke's end, with the valve covering both ports, the right diaphragm has moved until the valve connects the inlet pressure to its left or diaphragm port, and connects the slightly lower outlet pressure to its case port. The right diaphragm is now doing the driving and is moving toward the right. C shows a later relative diaphragm position, and D a still later one, in which the diaphragm and valve position can be analyzed as above. Still later when the cycle is completed the relative position of the parts will be as shown in A. When the cycle is complete it is obvious that the gas which has passed from the inlet to the outlet is equal to the amount expelled as each diaphragm is moved from its left position to its right position and then

back to its left position. By mechanically limiting this stroke of the two diaphragms, we can theoretically make this "swept" or displaced volume of a given value, and by providing a counting means—index—totalize in cubic feet the amount of gas which has passed through the meter.

Now that we have looked into the mechanism of the meter, we might digress a little to consider accuracies; what should we expect in the way of accuracy both in new meters and in the meters after a period of service? What "bogey" should we set on meter performance?

We often times hear the misleading statement that "A gas meter is as accurate as a watch". Sincere and earnest work on the part of meter manufacturing companies, gas companies and various other agencies still leave the gas meter far from being as accurate as a watch. This sad fact is recognized in practically all gas companies in their initial setting of meters; for almost invariably meters are set "slow" initially, thus preventing the possibility of overcharging the customer should the meters speed up and become fast. Errors of two per cent are usually permitted by governmental regulatory bodies, with occasional larger tolerances. A two per cent error in a watch means 28.8 minutes in twenty-four hours, and it isn't believable that a watch would be tolerated which would vary almost a half hour a day from true time.

From the easily and widely available records of accuracy of incoming meters, we can readily determine that meters do not stay absolutely accurate; that, quite often due to initial slow setting, the average of the proofs on incoming meters is usually slightly on the slow side, favoring the customer. This, of course, represents a loss of revenue to the gas company, and their efforts to "lean over backward" in the customer's interest is a confession of inability to provide extremely accurate measurement.

In a group of incoming meters tested there will be some fast, some accurate and some slow, the average probably being slow, as stated above. This variation from the truly accurate holds several possible sources of trouble. Fast meters, of course, are a potential trouble maker from the public relations point of view. Slow meters represent a loss of revenue, which is of course undesirable and also the probability of high bill complaint when the meter error is corrected. Thus, anything that can be done to minimize both fast and slow errors in meters should be carefully considered by both meter manufacturing companies and utility companies.

When we consider the job the displacement gas meter has to do and the conditions under which it must work, we are tempted to condone some of the errors which creep in. It is expected to measure at rates of flow from that of the smallest pilot light up to the meter's maximum rating; the external temperature and the gas temperature vary considerably; there are chemical effects of the gas on various parts of the mechanism; dirt and condensates are often present to do damage; and, like in all mechanisms, there is wear and deflection. Against this array of villainous effects the meter must fight to keep up its task of registering true cubic feet.

The records of any utility company on proofs of incoming meters can be gone over and from them a good idea obtained of accuracies. We must avoid saying with pride that the average of fast and slow proof is very near to 100 per cent correct, for half our meters could be 10 per cent fast and half 10 per cent slow, and our average would be exactly correct, yet both of these groups are sources of poor public relations. What we are interested in is any group or number which may be an excessive amount either fast or slow. We all know the danger of inaccurate measurement and I believe it behooves us to look carefully into the matter of any marked deviation of any group of incoming meters from standard. In other words, effort spent in eliminating measurement errors even though they do not seriously affect the total income, will be well repaid in consumers' satisfaction and public relations.

It is sometimes noted, with an implication that perhaps we are backward, that the domestic gas meter has not changed at all except in minor details or materials since its commercial beginning in 1844. We must not rush in too rashly and condemn a product because its design is old. The domestic dry gas meter has served well during its time and I think from the point of view of commercial measurement it can well hold its head up and point to an enviable record. Whether or not a higher degree of accuracy is desirable and worth an effort to make improvement, will depend somewhat on company records, and individual opinion. There are those who feel that a good jarring up and shaking up would result in measurement where we do not get as much variation from true accuracy as we get today, a measurement which could show perhaps an improvement in the average proof, and, what is more important, result in lessening the number of meters which depart by, let us say, more than two per cent, plus or minus, from true accuracy.

Before committing ourselves on this subject it might be well to investigate the causes of meter errors, to see just what lies behind those inaccuracies, which depart occasionally quite a distance from 100 per cent. The causes for inaccuracy we can divide into two groups. First, those which originate from poor workmanship and poor materials in new and repaired meters. Second, those errors which are due to design faults, occurring after the meter has been in service for a period of time.

The first group would include internal leaks, poorly ground valves, improperly packed stuffing boxes, misalignment, etc., which can in general be eliminated by careful supervision. These being matters of personnel we need not concern ourselves here.

The second group, those inaccuracies arising from design faults, are an interesting group and can stand a lot of investigation. The Europeans have given this matter of meter design considerably more thought than we have (referring now to domestic gas measurement). The result is a number of interesting designs which we may at least study. We do not necessarily admit that the result in the long run is a product which would economically replace our present devices, but they must at least merit our consideration.

We have pointed out above that gas measurement with a diaphragm meter is a matter of volume displacement only. The meter merely says that to the best of its knowledge it has permitted so many cubic feet to pass. This displacement is entirely a matter of the movement of the diaphragms, their "swept volume" as it is sometimes called. If anything changes, to change the volume "swept" by the two diaphragms, as the meter makes one complete revolution, this change in "swept" volume will result in inaccuracy. If, for some reason, the diaphragms resist going to the end of the stroke, the meter will be fast, i.e., it will show on the index a certain number of revolutions with the full implied displacement yet the diaphragms have

(Continued on page 76)

A. G. A. Distribution Conference

Shade Tree Protection—Pipe Corrosion and Coatings—Locating Gas Leaks—Pipe Joints, Pipe Standards—Research—among the subjects presented

THE American Gas Association Distribution Conference was held in Washington, D. C., from April 12 through April 14, 1937 with approximately four hundred men and one hundred wives in attendance. A series of meetings producing a vast fund of information and enthusiastic discussion were conducted by Chairman D. P. Hartson of Pittsburgh. Mr. M. L. Sperry, President of the Washington Gas Light Co. welcomed the delegates to Washington. Mr. Sperry stressed the necessity for inter-departmental co-operation to reach a definitely outlined goal. An essential to success, he indicated, was the selling of one's own organization on the value of the product. Publicity is an important factor. Ability and judgment are necessary not only in the executives, but all the way through the organization. Mr. Sperry particularly stressed the value of rewarding accomplishment instead of just criticizing mistakes. He indicated that with all the technical advantages the gas industry possesses, enthusiasm and stamina only were necessary to assure an increased load.

George W. Bean, A.G.A. Fuel Consultant at Washington, D. C., spoke on "The Necessity for Cooperation Between Distribution and Utilization Departments in Government Contracts." He pointed out that the intangible advantages of gas were not considered by Federal Bureaus when determining the advantages of fuels. In seeking contracts for supplying gas to Federal Departments or projects, local officials should be contacted first. Technical data is of primary importance to both the local and centralized Federal Bureaus to select a fuel. That the Government is interested in gas as a fuel was indicated by the fact that an employee of the Federal Government is now taking a specialized gas course.

"The Distribution Man's Part in the House Heating Program" was presented by H. B. Johns of Chicago. Mr. Johns showed the importance of having a Distribution Department's representative on any committee for the general or specific selection of equipment. He indicated the importance of a thorough gas heating survey not only for the purpose of selecting a particular unit, but to assure a satisfactory service. Chimney troubles were discussed and the means to remedy particularly difficult situations were presented.

Mr. A. Gordon King of the A.G.A. Headquarters staff presented a paper on "Shade Tree Protection." This paper outlined many of the problems now faced in the prevention and curing of damage to vegetable growth by gas and also the questions involved in the settlement of claims; that there is no known criterion of gas as a cause for such damage and there is considerable controversy even among botanists as to the particular constituents of gas which might be the destructive cause. A considerable amount of material is included in appendices of Mr. King's paper, an important part of which is a complete bibliography on the subject.

Mr. E. A. Munyan of Cincinnati gave a verbal description of the recent flood conditions in the vicinity of Cincinnati. The men worked in twelve hour shifts so as to prevent physical over-exertion. They were quartered at hotels where they were also fed. The question of feeding

A Happy Pose
L. A. Dixon, Pitsburgh (left) draws a broad smile from Willard F. Rockell, Pittsburgh.

Long Distance Sextet
Front:—C. D. Robison, Omaha; J. D. von Maur, Toronto; H. L. Gaidry, New Orleans.
Back:—Guy Cornfield, Los Angeles; Martin I. Mix, Chicago; F. M. Goodwin, Boston.

Howdy Colorado!
Left:—D. P. Hartson of Pittsburgh welcomes George J. Heckendorn of Denver.

Snapped at the Distribution Conference. Photos Courtesy of American Gas Assn.

A Pipe Line is as Tight as its *Weakest* Joint

X-PANDO PIPE AND JOINT COMPOUND is NOT just another "pipe dope." It is a dry, mineral powder—mixed with cold water only—used in any temperature in which a man can work. It is non-poisonous, insoluble in hydrocarbons and a non-conductor. As it sets, it expands slightly . . . after a few hours of hardening, it literally becomes part of the pipe or the surface to which it is applied.

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When mixed to the consistency of syrup and applied to threads with a brush or paddle, all one has to do is to tighten the joint. X-PANDO Pipe and Joint Compound does the rest. Its expanding action completely corrects all irregularities caused by imperfect threads. No wicking is necessary on any thread.

FOR BELL AND SPIGOT JOINTS

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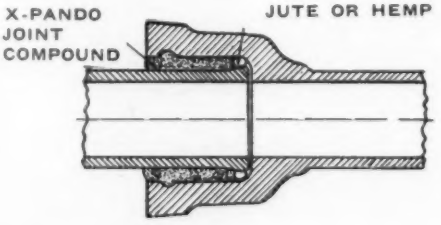

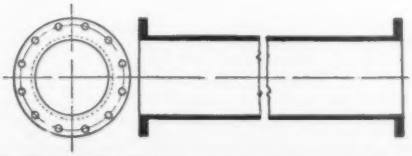

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was a difficult one to solve and the amount of food consumed may be visualized when it is mentioned that as much as fifteen hundred cases of soup were used by the Cincinnati crews. During the whole period there was not a single employee drowned or seriously injured in maintaining gas service in and around Cincinnati. There were no gas fires and no explosions from gas. Continued vigilance was necessary to eliminate such hazards as 50,000 gallons of oil caught fire and 1,000,000 gallons of gasoline broke into flames after being accidentally released into the river. The service rendered was particularly valuable in producing a favorable public reaction.

On Monday afternoon a series of five luncheon conferences were held, the subjects covered being meters, customer service, pipe, portable equipment and employee training. The attendance at these conferences evidenced the continued interest in this means of exchanging information.

Mr. F. M. Goodwin of Boston presented the following motion:

"Mr. Chairman. Be it resolved that the Distribution Committee of the American Gas Association, in conference at the Wardman Park Hotel, Washington, D. C., express its admiration for those gas distribution engineers who so ably carried on against tremendous odds during the Ohio Valley flood and who reflected much credit not only on themselves, but on the entire gas industry."

Mr. C. F. Turner of Cleveland reported for the committee on pipe coatings and corrosion. An outline of the material to be published by the association was presented. During the discussion of this paper, Dr. Speller recommended a study of inhibitive primers.

Dr. Lyman J. Briggs, director of the National Bureau of Standards gave a talk on "Bureau of Standards Research." Dr. Briggs stated that eight hundred and fifty persons are engaged in the Bureau's work. Eight buildings on a fifty acre plot are used to house the equipment. The comparison of instruments with the standards maintained by the Bureau is an important function of the Bureau of Standards. The testing of materials for various federal agencies occupies considerable time. Research is the most fundamental activity and is divided into basic and applied. Dr. Briggs feels that basic research may increase the wants of people and thereby affect employment and may assist in stabilizing the quantity of work. He stated that there is thought being given to having the government go more actively into applied research. Some associations maintain research associates or fellows at the bureau. The petroleum industry now has ten men occupied at the Bureau on research problems. Dr. Briggs also stated that such activities as are pursued by the A.G.A. Laboratory at Cleveland should be encouraged.

Dr. Scott Ewing, research associate of the American Gas Association at the Bureau of Standards presented a paper on "Engineering Principles Applied to the Soil Corrosion Problem." Dr. Ewing briefly covered soil corrosion processes, the occurrence of leaks as a measure of corrosiveness, pit depth-area relation, pit depth-time relation, and specifications for pipe coating materials.

A. V. Smith of the U.G.I. Company, Philadelphia presented "The Theory and use of Cathodic Protection." This paper successfully described the theory of corrosion in simple terms and briefly indicated how cathodic protection would be applied to minimize the effects of both galvanic and stray current corrosion.

It Must Have Been Good
Left to Right:—C. D. Robison, Omaha; D. P. Hartson, Pittsburgh; H. W. Hartman, New York.

E. F. Schuldt of the People's Gas Light & Coke Company of Chicago, described a new development in a paper entitled "The Precision Method of Locating Gas Leaks." This development makes use of two gas main stoppers of the bag type, firmly attached to a semi-rigid bar which maintains them a distance of eight feet apart. This part of the apparatus is attached by flexible tubing to a gauge board located above ground. The bags are pushed into the main by means of a semi-rigid metal strip. The bags are inflated and deflated at various points along the main. Pressure readings between the two bags when inflated are transmitted by tubing to the instrument board and any leakage is indicated by a pressure drop.

On Tuesday afternoon, the majority of the delegates to the conference made an inspection trip to the Bureau of Standards. All types of the work conducted by the Bureau were viewed and as a climax an actual test on a wooden beam was made on the most powerful testing machine in the world.

Mr. D. P. Allen of Washington, presented a progress report of the sub-committee on meters and metering. Mr. Allen presented the conclusions reached on studies being made on "The Accuracy of Meters at Small Rates of Flow, the Development of Different Meter Construction, the Simplification and Standardization of Meter Repair, Cost Accounting, The Factor or Ratio System of Meter Repair Cost, Checking on Comparison and Meter Performance Records, Inventory Records and Repair Cost Records Essential to Establishing Meter Replacement and Repair Policies."

L. W. Tuttle of Oak Park, Ill., reported for the Sub-Committee on Pipe Joints and Pipe Materials. The work of this committee includes a study of the theory and metallography of welding, the effect of a change-over from manufactured gas to natural gas on pipe joints, and the specifications for the installation of bell joint clamps. The result of some questionnaires on this subject was presented in the report.

R. E. Finley, Vice President of the Dayton Power & Light Co. presented a paper on the "Further Use of Carboseal in Reducing Joint Leakage." Some accurate tests of the effect of Carboseal in the mains were tabulated, costs were listed for certain of the tests made and the results of a questionnaire presented.

Stephen P. Cobb, Consulting Engineer, Ebasco Service, Inc., New York, presented a thorough study on the effect of a varying water vapor content of gas on volumetric conversion factors. Mr. Cobb simplified definitions of the various laws pertaining to gas measurement and the application of theory to this purpose. The paper included a summary of the various methods now used for determining the vapor content of gas. The tables and charts presented summarized a considerable amount of study on the subject. Mr. Cobb has indicated that it is important to recognize the BTU of a gas as existing in the pipe transmis-

sion line rather than as determined after passing through calorimeter.

C. D. Robison, Omaha, Nebraska, presented "Changes Occurring in a Distribution System as a Result of Changes in the Characteristics of the Gas Supplied." Mr. Robison recognized the need for comparative data before and after such changes, and presented supplemental data to indicate the numerical values of such changes. The tables presented are also valuable in indicating the distance fogging may be expected to travel. Methods of determining the relative humidity and installing test filters or tar cameras were included.

Erick Larson of the Long Island Lighting Co., New York, made a report for the committee on gas main structural strength. The report included a presentation of the purposes, program and contemplated results as visualized by the committee to date.

C. C. Simpson of the Consolidated Edison Co., New York, reported for the committee on Cast Iron Pipe Standards. This committee is cooperating with the American Standards Association and it is felt that the work will not be concluded for at least another two years.

Part of Wednesday afternoon was consumed in reports by the chairmen of the various luncheon committees. These reports briefly summarized the many phases which were discussed at each of the luncheon conferences and allowed the members present to secure a brief knowledge of what occurred at sessions which they were unable to attend.

Effect of Varying Water Vapor Content of Gas on Volumetric Conversion Factors

By Stephen P. Cobb

Consulting Gas Engineer
Ebasco Service Incorporated
New York, N. Y.

IN PRESENTING this paper, I would like to offer a rather brief summary which will cover the fundamentals of the subject and which will leave time for discussion.

With the increasing use of dehydration and rehydration of gas and with the greater use of natural gas which has often been compressed in transmission, a condition of under-saturation is often met, even though previously the gas may have been practically saturated with water vapor. A workable method for determining the conversion factors, taking into account the actual water vapor content, rather than assuming that the gas is saturated in all cases, is presented.

In order to avoid confusion as to the exact meaning of certain terms which are used in this discussion, the following definitions are suggested.

Relative Saturation

The *relative saturation* of a mixture of gas and vapor is defined as the ratio of the partial pressure of the vapor in the existing mixture to the partial pressure of the vapor which would exist in a mixture of the same gas and vapor saturated at the existing temperature and total pressure.

This term also represents the ratio of the partial volume of the vapor in the existing mixture to the partial volume of the vapor in a mixture saturated at the existing temperature and total pressure and also the ratio of the weight of vapor per unit volume of the existing mixture to the weight of vapor per unit volume of a mixture saturated at the existing temperature and total pressure.

It is evident from this definition that the relative saturation is a function of the composition of the gas, the temperature and total pressure of the mixture and the nature of the vapor. While the term *relative humidity* may be used synonomously with relative saturation, in cases where the vapor is that of water, this term is so closely identified with mixtures of air and water vapor in meteorological work that it is believed to be in the interest of clarity to confine its use to such mixtures and to use the term relative saturation when dealing with mixtures of water or other vapor and gases other than air.

* *Abstract of a paper presented at the Distribution Conference, American Gas Association, Washington, D. C., April 12-14, 1937.*

Percentage Saturation

The *percentage saturation* of a mixture of gas and vapor is defined as the ratio of the existing weight of vapor per unit weight of dry or vapor free gas to the weight of vapor which would exist per unit weight of dry gas if the mixture were saturated at the existing temperature and pressure.

Care must be used to avoid confusion in the use of the terms relative saturation and percentage saturation as, in general, they are not equal. It is believed that the use of relative saturation will usually be found most convenient.

Dewpoint

The *dewpoint* of a mixture of gas and vapor is defined as that temperature at which the partial pressure of the vapor equals the partial pressure of the vapor in a mixture of similar gas and vapor saturated at the existing total pressure. If an unsaturated mixture is cooled, with no change in total pressure, the percentage composition of the mixture and the relative amounts of the various components and therefore the partial pressure of the vapor will remain unchanged while if a saturated mixture is cooled, with no change in total pressure, part of the vapor will be condensed and the partial pressure of the vapor will be lowered.

Mr. Cobb's comprehensive paper carries many curves and charts, tables and diagrams, together with an appendix covering certain fundamental laws or principles. Copies may be obtained through American Gas Association Headquarters in New York.—Ed.

Partial Volume

From the nature of a gaseous mixture it appears that the molecules of each component are disseminated through the entire volume of the mixture. It is convenient, however, to refer to the partial volume of a component in such a mixture, which may be defined as the amount by which the volume would be reduced by the removal of that component with no change in the total pressure.

Variation of Partial Pressure of Water Vapor

The variation of the partial pressure of water vapor in a mixture of gas and water vapor with a change in temperature or pressure is based on the following principles.

1. If a mixture of gas and water vapor is expanded by an increase in temperature, while the total pressure remains constant, the partial pressure of the water vapor will remain constant. This follows from the fact that the partial pressure of the water vapor is equal to the product of the total pressure of the mixture and the mol fraction of the water vapor, both of which factors in this case are constant.

2. If a mixture of gas and water vapor is expanded by a decrease in total pressure, while the temperature remains constant, the partial pressure of the water vapor will decrease in direct proportion to the decrease in the total pressure. This follows from the fact that, as stated above, the partial pressure of the water vapor is equal to the product of the total pressure and the mol fraction of the water vapor. In this case the total pressure is variable while the mol fraction is constant.

3. If a mixture of gas and water vapor is contracted by an increase in total pressure or a decrease in temperature, or both, similar principles apply and the partial pressure of water vapor will be increased in direct proportion to the increase in total pressure. This is subject to the provision, however, that when the contraction reaches the point where the partial pressure of the water vapor in the mixture equals the partial pressure of water vapor in a mixture saturated at the existing temperature, condensation will occur on further contraction and from that point, the partial pressure of the water vapor will equal the partial pressure of water vapor in a mixture saturated at the existing temperature.

4. In a mixture of saturated water vapor and any gas, the partial pressure of the water vapor will be the same at any given temperature irrespective of the composition of the fas so long as the total pressure remains constant. The partial pressure of water vapor in a mixture of saturated water vapor and any gas may be taken from the steam tables.

5. The mol fraction or mol percentage of anyco mponent of a gaseous mixture is equal to the volumetric fraction or percentage of that component as determined by analysis.

Basic Formula for Volumetric Change

The basic formula for the change in volume of a mixture of gas and water vapor, due to a change in temperature pressure or both may be expressed as:

$$\frac{V_2}{V_1} = \frac{P_1 - w_1}{P_2 - w_2} \times \frac{T_2}{T_1}$$

where V_1 = Initial Volume
V_2 = Final Volume
P_1 = Initial total absolute pressure
P_2 = Final total absolute pressure
w_1 = Initial partial pressure of water vapor
w_2 = Final partial pressure of water supply
T_1 = Initial absolute temperature
T_2 = Final absolute temperature

This formula is based on the assumption of the validity of the Simple Gas Law, which is satisfactory when dealing with gas at reasonably low pressure and normal temperatures.

Volumetric Conversion Factor

As aids in computing the volumetric conversion factor for a change in temperature or pressure or both, taking into account the actual water vapor content, six charts have been prepared. The method of using these charts is explained in the paper.

Heating Value Determination

A specific case where the use of actual water vapor content in determining volumetric conversion factors is important arises in connection with heating value determinations. When using a calorimeter of either the Junkers type or the Thomas type, the heating value is determined for gas which is essentially saturated due to the fact that it is measured through a wet meter. The gas in the line may be distinctly under-saturated and it is often important to determine the heating value of the gas under the conditions actually existing in the line and to do this requires use of the volumetric conversion factor which takes into account the actual water vapor content.

Dewpoint Determination

There are three methods for determining the dewpoint of gas: (1) The Gravimetric Method, (2) The Dewpoint Method and (3) The Psychrometric Method.

In the first or Gravimetric Method, the water vapor in a measured quantity of gas is absorbed by a suitable absorbent and the amount determined by weighing the tubes containing the absorbent before and after the passage of the gas and from the data so obtained the necessary calculations are made.

In the second or Dewpoint Method, the temperature of the dewpoint is determined directly. In the usual types of apparatus for this test, the gas is passed over a polished metal cup containing a refrigerant. The temperature of the refrigerant is lowered by evaporation and the temperature of the dewpoint taken as the temperature of the refrigerant at which dew is deposited on the polished surface.

In the third of Psychrometric Method, the gas is passed over two thermometers in series, the first thermometer bulb being "dry", while the second is covered with a porous wick or sleeve which is kept saturated with water. The gas, if unsaturated, in passing over the wet bulb absorbs water and the amount so absorbed depends on the quantity of water vapor already in the gas. The depression of the wet bulb thermometer reading depends on the heat of vaporization of the water so absorbed. From the difference in the readings of the thermometers and the nature of the gas being tested, the temperature of the dewpoint or the water vapor content of the gas may be calculated.

Of these methods, the first is essentially a laboratory method not well adapted to field use though it is generally considered the most accurate.

In using the second method, it is desirable to make the test at as high a pressure as possible in order to avoid the lowering of the dewpoint by the expansion of the gas. Determinations of dewpoints lower than 5° F. will be found difficult. In any case, a certain amount of practice is necessary in using this method.

The third method is probably the most generally used but it is more involved than the second method and requires careful attention to details if more or less inaccurate results are to be avoided.

Various forms of apparatus for making these tests are described and the formulas for calculating the dewpoint from the data shown in the tests are given.

It is of interest to note that since the paper was prepared, a new design of apparatus for dewpoint determination has been developed.

A joint committee of the American Society for Testing Materials and American Gas Association is working on the general subject "Determination of Water Vapor Content of Gaseous Fuels". Conclusion of the investigation by this committee and publication of their report will add much to our knowledge of this subject.

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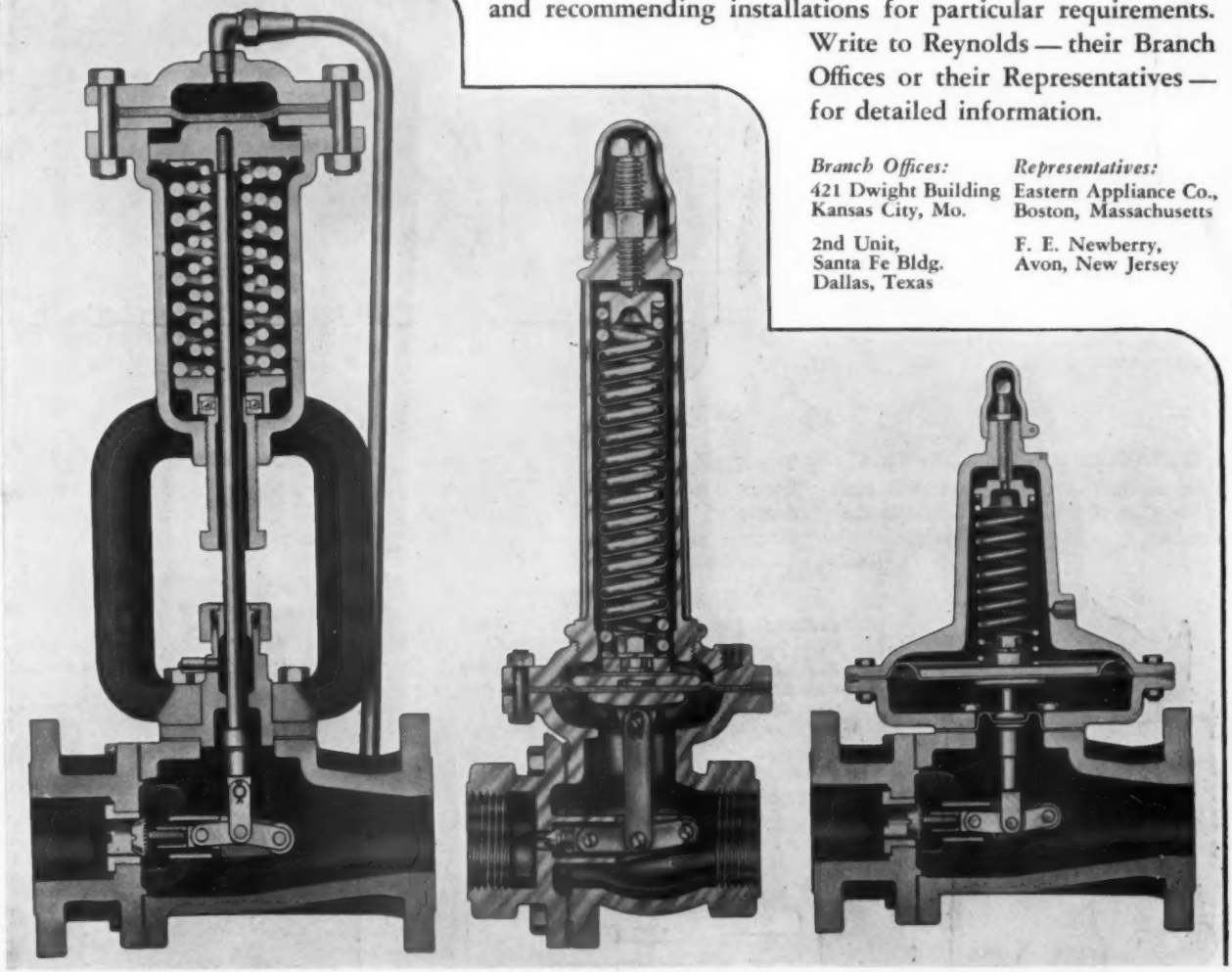

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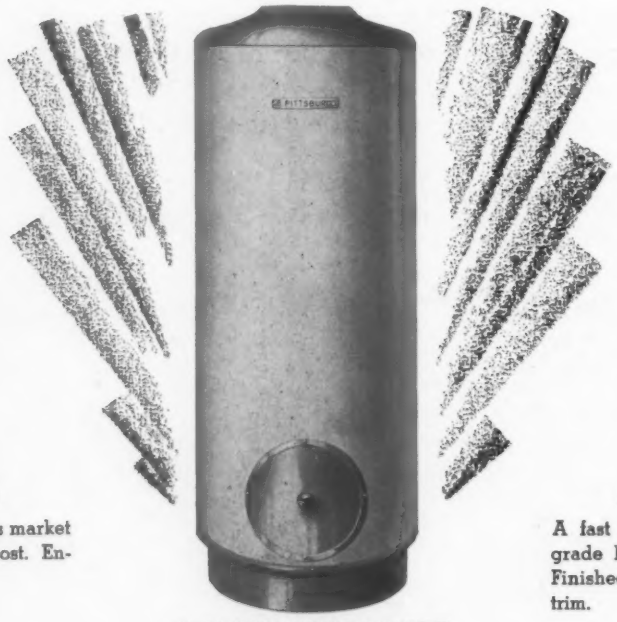
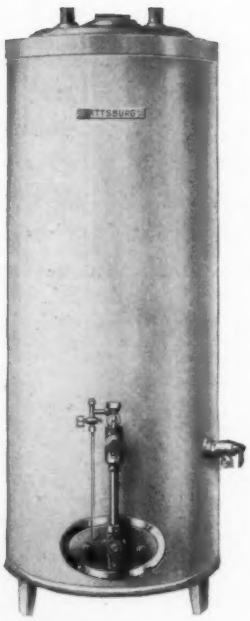
INSTANTANEOUS MODEL No. 4

Fully automatic, with triple control and safety pilot, this coil type heater is the standard of all water heater values.



STREAMLINED DE LUXE MODEL M-2

This entirely automatic gas storage water heater is streamlined with all controls concealed. Finished in ivory enamel with chrome trim.



STORAGE MODEL M-1

A fast recovery, heavily insulated, high grade heater in the medium price class. Finished in long life enamel with aluminum trim.

•

CONTINUOUS FLOW MODEL No. 38

Copper fin-type design to sell at medium price. Thermostatic control. Entirely automatic and economical.

EXCLUSIVE FEATURES

1. Bonderizing—preservation of sheet steel from rust and deterioration.

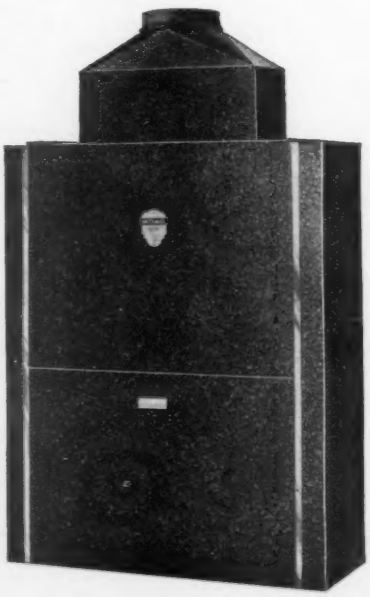
2. Airtrol—Reduces standby loss by closing of air circulation when gas goes off.

3. Channel Shell—Insures constant conductivity of heat to tank at all times.

LION TANK HEATERS

MODEL 1½B

MODEL 1½M



THE PITTSBURG WATER HEATER CORP., PITTSBURGH, PENNA.

Window Displays As A Publicity Medium

By C. Foster Clark

THE value of publicity to an institution is an intangible value, to which no definite measure can be attached. That it is of paramount importance, however, can be readily seen by an inspection of our streets, our public vehicles, and our reading material, where billboards, street car signs and printed advertisements respectively flaunt the values of the wares they describe or the institution they represent. And thousands of dollars are spent on radio programs alone every day, solely for the sake of publicity.

Small wonder that the large department stores of our cities spend huge sums of money annually for the upkeep of their display windows, aptly described as "the eyes of the store". A display window has publicity features not to be found in any other kind of advertising. It has every useful feature of printed advertising and in addition offers the unique advantage of three dimensions, into which may be put light, color, sound, motion, illustration, copy or even actual products themselves, just as they may be purchased or used by the buyer.

The window shopping habit has increased tremendously among the American people of late, largely due to the improvements in display technique which have taken place during the past two decades and which have made of our display windows foci of interesting products and developments. More new products are offered the public every year than ever before and the most successful of these find their way into the display window in some form or other. Every window shopper is either a potential customer or a potential agency for word-of-mouth advertising. The latter possibility outranks any form of printed publicity; it is the oldest, if not the surest, means of imparting information.

The same principles which apply to direct selling through the display window are equally effective when applied to institutional windows. In displays of this type, where direct action is not usually expected or sought, the chief object is the enhancement of the reputation of the institution rather than the dressing up of articles for sale. After all, we in the gas industry are selling a service rather than a tangible product and our principal aim should be the emphasizing of the value of the service that we can and do render.

The functions of an institutional display are: first, to attract the attention of the passer-by; second, to create interest in the message of the window; and third, to leave a favorable impression in the minds of the onlookers.

Attention is comparatively easy to obtain, several methods being in common use in display windows. The easiest way, of course, is by the use of motion, particularly when the motion is performed by human beings. We humans are always intensely interested in seeing what the other fellow is doing; one need but observe the crowds that gather around a street hawker or an excavation for a new building in our cities to perceive the truth of this statement. Even mechanical motion is always of interest, as it simulates life in some degree.

Another common method of attracting attention is by means of

A modernistic background used to display a popular brand of meat products. The neat and simple lines of this background add to the attractiveness of the holiday wrappings.

This window attracted the eye by use of a colored Neon Sign and contrasting colors in the background.

sound. A radio loud-speaker or the sound of a voice or music will always draw attention. Unfortunately, the use of sound has become generally associated with the type of store which caters to the masses, such as cut-rate drug stores, radio stores, bargain sales and the like. Caution must be exercised, then, when using sound in the high-class display windows of a public service organization.

A third method of securing attention is by the use of color and pleasing design. This must be the chief reliance of the gas company display man and is capable of excellent results when used by trained hands. Often included in this is the problem of correct window lighting, which has engaged the attention of many expert minds during recent years.

Once the attention of the passerby has been attracted, it is the job of the display window to hold his interest. Show him something of value to him; something that contributes to his comfort or to his pride of possession, and you have taken a long step towards the winning of his attention. Or if you can show him something unusual, something that intrigues his imagination, his human curiosity will compel him to see what the display is all about.

Now comes the test as to whether the onlooker will remember what he has seen and whether it impresses him in a favorable manner. This is the most difficult aspect of an institutional display to judge and there is no way in which it can be measured directly. Only if one hears from various sources favorable comments on such displays, can it be assumed that the latter are proving their worth as builders of prestige and reputation.

The display windows of a gas company offer advantages for institutional advertising which are unique. Not only are the windows usually located in a busy part of the community, but they must also be passed every day by persons entering the building to pay bills, to adjust bills, to request new services and to buy appliances. Day and night, three hundred and sixty-five days in the year, these silent salesmen are selling the idea of gas to all who pass in front of them—telling them over and over, in countless different ways, why gas is the best for the home as well as for the factory.

The gas company window displays of today are a far cry from the older days, when a few ranges and a heterogeneous collection of gas lights, mantles, stove lighters and the like were rather indiscriminately dumped into the windows and left to shift for themselves. Many gas companies now employ experienced display men, who are thoroughly acquainted with the principles of effective displays and are able to take advantage of the unusual possibilities inherent in the display windows of their employers. Instead of the ill-assorted mass displays of former years, we now have the theme of gas service developed in innumerable ways to show the many advantages of using gas. Its cleanliness, flexibility, accurate control and above all, its economy, are featured in novel and interesting ways.

One of the most interesting developments of recent years is the use of industrial window displays as a potential agency for the publicizing of the advantages of gas for every use where heat is required. The results of planned displays of this nature have been most gratifying and have not only opened the way for improved contacts with industrial users of gas, but also have shown the public in a vivid manner the thousands of ways in which gas is being used today.

In many ways the planning and installation of industrial window displays involves problems similar to those encountered in the construction of appliance or promotional displays, but there are also significant differences. The industrial display, as a rule, does not attempt to sell gas for a specific purpose; its general theme is the expression of the widespread acceptance of gas for use wherever heat is needed. It does not aim to obtain sales directly; its purpose is to create the much more subtle and lasting impression of public endorsement. Once this has been secured, the door is open to expansion of greater magnitude than would ever have been dreamed about in former times.

The gas industry stands on the threshold of an era of prosperity such as we have never known before. We have the background of an industry that does not know defeat; it is up to us to maintain this record and take advantage of all our assets for the firmer establishment of ourselves in the confidence of the public. Not the least of these assets, and one most readily available is the display window. Let us seize this opportunity to impress in no uncertain manner upon the public the fact that we are among the leaders of the new Golden Age.

"March of Time" Broadcast

Sponsorship of the "March of Time," now being broadcast over the CBS network by Servel, Inc., manufacturer of the Servel Electrolux gas-operated refrigerator, ties in with the Spring and Summer refrigerator selling campaigns conducted by the gas utilities in all parts of the country. The broadcast began April 15 to continue for thirteen weeks.

Use of radio to carry the message of Servel Electrolux to thousands of people on the gas lines who may be in the market for a new refrigerator is part of the extensive advertising campaign carried on by Servel, Inc., in magazines, trade papers and daily newspapers. Special attention will be given to emphasizing the backing of Servel Electrolux by the American gas industry in the commercial portion of the broadcast.

The "March of Time," now in its seventh year, is regarded as one of the most popular programs on the air, having stood highest in several annual polls conducted by radio editors throughout the country. Other local and national polls have given a high place to the broadcast because of its entertaining and educational character.

As hosts of radio listeners know, the "March of Time" is a dramatic representation of leading news events that have been in the public eye a short time before the broadcast is given. The program will be broadcast over forty-five stations every Thursday evening, the hours being 10:30 Eastern Standard Time; 9:30 Central; 8:30 Mountain, and 7:30 Pacific.

Commenting on the program, Louis Ruthenburg, president of Servel, Inc., said: "Servel Electrolux 'March of Time' will give a strong impetus to gas refrigeration, because it will carry the story of this modern gas appliance into the homes of millions at the psychological time—during the height of the refrigerator selling period. Moreover, this distinguished radio program will build good will for gas and gas service."

George S. Jones, Jr., vice-president and general sales manager of Servel, Inc., said: "Servel Electrolux has many advertising and promotional activities, but none exceeds in scope or possibilities our sponsorship of the 'March of Time' radio program which began April 15. It offers to every outlet for Servel Electrolux refrigerators an opportunity to mark up an all-time high in sales and profits."

Arc Welding Instruction

"Building a Career in Arc Welding" is the title of a 12-page bulletin issued by Lincoln Electric Co. of Cleveland. Giving numerous illustrations of arc welding practice it describes the set-up and conduct of welding courses as carried out in the Lincoln Welding School for "rookies" and veterans. Advanced courses are under the direction of E. W. P. Smith. The courses in arc welding are on a non-commercial basis,—most of them practically free of charge.

THE SYMBOL OF UNIT HEATING

These Unit Construction "Variety" Bake Ovens command ready acceptance and produce

A Profitable Commercial Load

VARIETY ovens are ruggedly constructed on modern lines of galvannealed iron with insulated walls, quick acting doors and chromium plated fittings.

They bake a VARIETY of goods at the same time having separate thermostat control for each baking chamber unit. New units may be added at any time.

By the use of a circulating heat system, heat is evenly distributed and they are more economic in gas consumption than most direct heat ovens. Cake, bread and pastry can be baked at the same time. Their design and finish dress up any bakery, restaurant or kitchen.

They replace other fuels and obsolete gas equipment.

The oven shown is 6'-6" high by 6' deep by 7'-6" wide.

This Complete Bakery Installation shows a 2-Section, Four Chamber Martin VARIETY Oven with gas connections and controls.

Here is a big Sales Opportunity among

Bakeries Restaurants
Hotels Hospitals
Schools Churches
Clubs Chain Stores

Ask for descriptive data and selling aids for salesmen.

MARTIN OVEN COMPANY
420 Lexington Ave. New York

STACEY BROTHERS GAS CONSTRUCTION CO.

CINCINNATI, OHIO

ANNOUNCEMENT

At a Small Cost to Your Company Our Gas Holder Inspection and Maintenance Department with an Especially Trained Personnel of Field Gas Holder Engineers Can Be of Service to Your Company in Protecting Your Gas Holder Investment.

THERE ARE A GREAT MANY TOLL GATES ALONG THE ROAD OF NEGLECT AND THE LIFE OF A GAS HOLDER IS MEASURED BY ITS CARE

We Suggest You Write Today for Further Details About Our Annual Inspection and Maintenance Plan

Chaplin-Fulton Regulator on 4" Fuel Line to Compressors of Gas Booster Station, Oklahoma City, Oklahoma, 1937.

Always Well Fed—But Never Too Well

Gas pressure in the fuel line is constant, therefore the engine does its work steadily and well, the compressors are never over-driven or run too slack, the booster-station performs unfailingly, and the total result is as it should be.

Just a normal, typical Chaplin-Fulton installation is pictured, the regulator in question being the Low Pressure type without Automatic Cut-off. Chaplin-Fulton equipment for all requirements of gas control has been in use more than 50 years. Catalog and full information on request.

CF

The CHAPLIN-FULTON MFG. CO.

28-40 Penn Ave. Pittsburgh, Pa.

Welded and Seamless Steel Pipe—

Its History and Development

SOMETIME in the dim ages of the remote past, early man conceived the idea of conveying water through a reed, a hollow tree or a bamboo stem, and thus the pipe industry, so important to modern civilization, was born. Bamboo, which in tropical countries grows five or six inches thick at the base, was probably used with joints cemented with clay. Even today bamboo is so used by Chinese gardeners for piping water for short distances along the surface of the ground.

These primitive forms of pipe were not used solely for conveying water. The Greek legend tells us that the great god Pan made the first musical pipes from reeds growing in a swamp. One of the forerunners of the gun barrel was a hollow reed through which African natives blew a pebble with enough force to bring down a bird at some distance.

As man became more ingenious he fashioned artificial pipe from various materials he found at hand. The pottery tube was made by the ancient Egyptians in Africa and by the Aztec Indians on our own continent.

The Romans, in the time of the Caesars, had wooden pipes which were simply bored-out logs. But in their public baths, they used lead pipes, with bronze faucets closely resembling our modern faucets. Specimens of these lead pipes have been dug up in the ruins of the buried cities of Pompeii and Herculaneum.

Wooden pipes, like those used by the Romans, were employed in the first water supply systems built in colonial America. A bored-log system was laid in Boston, Mass., in 1652. A water works system, utilizing bored logs, was built at Bethlehem, Pa., in 1754.

No one thought of using iron for making pipe until the advent of gunpowder, which was discovered in Germany in 1386. Bronze, which was the first material used in making cannon, was found to be too expensive for quantity output. At the same time, smaller firearms came into vogue and called for a slender, thin-walled tube for which wrought iron was admirably suited.

Wrought iron tubes for gun barrels were all laboriously manufactured by hand. An iron plate or strip was bent to form a skelp. The edges of the skelp were then welded together, a few inches at a time over a rod or mandrel, by the blows of the smith's hammer. This process was lap-welding.

In 1812, an Englishman named Osborne patented machinery for welding barrels of firearms and other iron tubes. A tilt hammer replaced the smith's brawny arm.

This rather tedious method of manufacture sufficed until a Scottish inventor, William Murdock, succeeded in making coal gas for illuminating purposes. He made his first short gas pipe line by screwing together discarded gun barrels, of which there was an abundant supply left over from the many European wars.

When gas jets really began to take the place of the old oil lamps, the gun barrels, of course, gave out and wrought iron pipe of more uniform size and thickness was demanded. In 1824, James Russell brought out the butt-welding process. By this method, the edges of the skelp were butted against each other instead of overlapped. Since the tilt hammer was still used for the welding, the process was as slow as the old lap-welding method.

The following year, Cornelius Whitehouse devised a quicker means of welding wrought iron tubes by drawing a heated flat plate through a die by means of a chain. This forms the basis of our modern "bell" process.

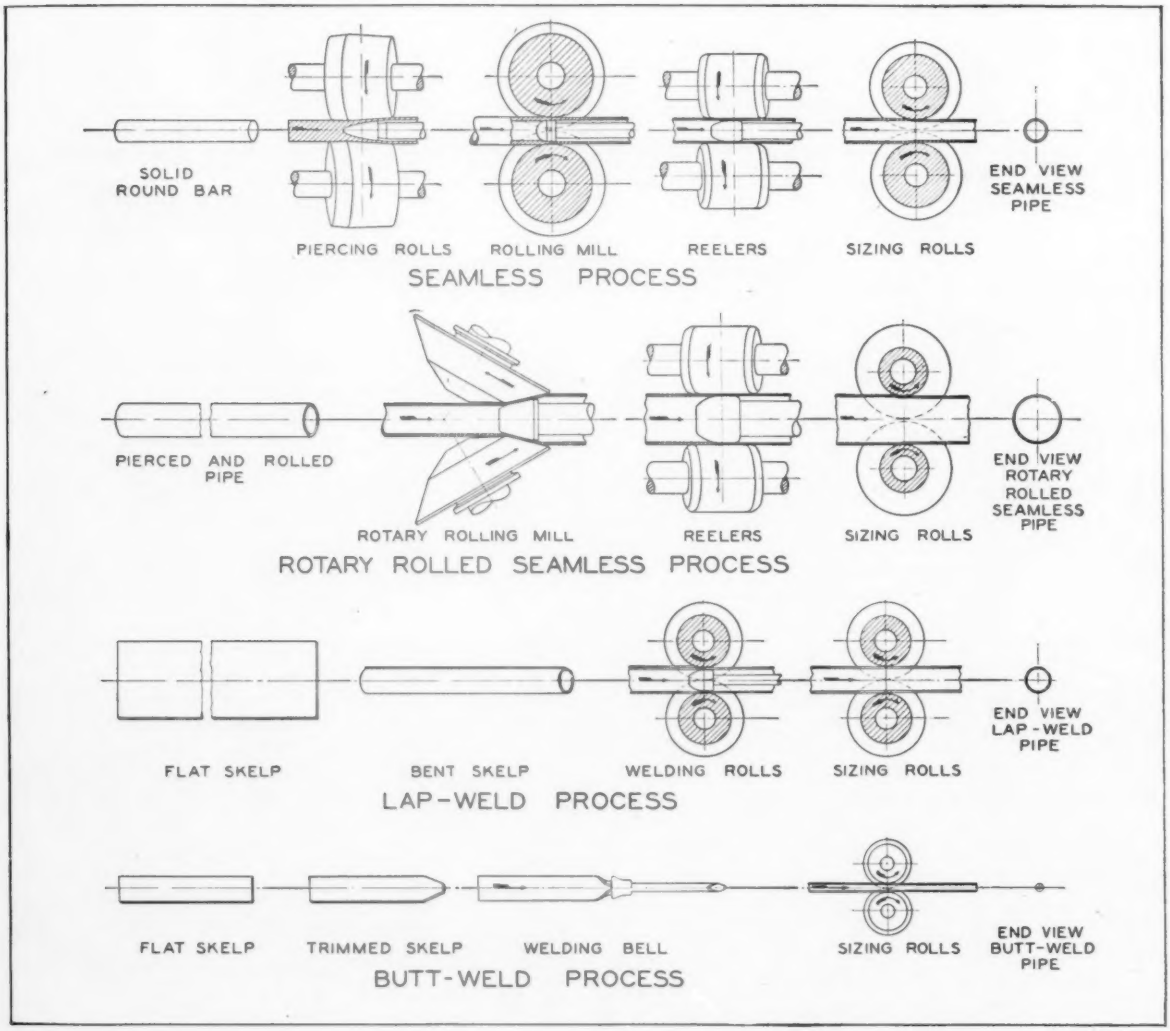
So far, inventions in the tube and other industries had all originated in Europe. In fact, American industries were just cutting their first teeth. But American industries were growing and were demanding American pipe. Between 1830 and 1834, the first furnace in the United States for making butt-weld pipe was set up in a Philadelphia cellar by Morris, Tasker & Morris, forerunners of Morris, Tasker & Co.

The welder at this Philadelphia furnace was a man who had learned his trade in England. Within a few years, Morris, Tasker & Morris outgrew their cellar and built a mill and machine shop which became known as the Pascal Iron Works. The Pascal works in later years made a valuable contribution to the American pipe industry through its superintendent, Robert Briggs, who, in 1862, compiled formulas and tables which have been adopted as standard for pipe manufacture and are now widely known as American Standard (Briggs') Pipe Thread.

In 1868, Boston witnessed the founding of a small pipe mill by the Flagler brothers, who had previously distributed various lines of iron merchandise, including boiler tubes manufactured by Morris, Tasker & Morris. The Flagler mill, later transplanted to Pittsburgh, grew into the National Tube Works.

For years wrought pipe was made of iron. It was not until the eighties that experiments gave rise to the hope that pipe could be made of steel. Veteran pipe men, for the most part, pooh-poohed the idea, but in 1888 Thomas J. Bray, superintendent of the tube department of Riverside Iron Works, Wheeling, W. Va., was successful in making a trial lot of pipe from 30 tons of steel skelp.

Since that time the art of making steel pipe has been steadily improved. To the lap-welding and butt-welding processes have been added other methods of which the most important is the seamless or weldless process.

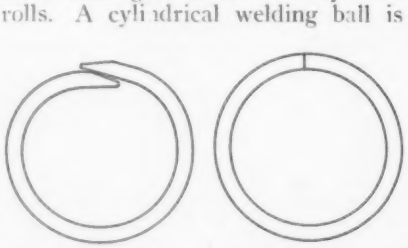


Speaking in broad terms, the pipe in present day use is either welded or seamless. The welded pipe is known by terms indicating the method of welding employed—butt weld, lap weld, hammer weld, electric weld, etc. The term "seamless'," however, relates to a quality of the pipe itself, without reference to a particular method for securing the quality.

Butt weld pipe, as the name implies, has the edges of the strip of metal from which the pipe is formed, simply butted together, and their junction welded.

The process is to heat flat strips of metal, of a length suitable for the finished length of the pipe, to welding temperature, and then to draw the strip through a funnel-shaped opening in a die called the welding bell. In the funnel-shaped passage, the flat strip is bent into tubular form with the edges butting together. The round opening in the welding bell is of a size to cause pressure on the butted edges and thus effect the welding of the edges.

Lap weld pipe is rolled to tubular form before heating to welding temperature. The edges of the plate are beveled and overlap when the plate is formed to a tube. The welding heat is applied to the overlapped edges, and the pipe is then entered in a circular groove formed by two rolls. A cylindrical welding ball is



held in position in the groove, and the tube, passing through the rolls and over the ball, has pressure applied to the over-lapped edges which effects the welding.

The hammer weld method is used mainly for very large diameters. This type of weld is probably of greater uniformity of strength than any of the others. The process is more costly than other types, and so its use is limited to special work.

Electrical welding embraces many different procedures. All of them involve heating to the welding temperature, at least, and some to the temperature of the melted metal. The pipe is formed from plates or strips, as in the other welded process, and the edges joined by a weld.

Welded pipe has been an indispensable factor in civilized life for the past hundred years. Its serious fault of an occasional defective spot in the long length of the weld has been condoned as inherent in the process. After a century of effort, the fault is still present. This was the incentive that led to the development of seamless pipe.

The Shelby Steel Tube Co., Shelby, Ohio, whose works were taken over by National Tube Company, was the first seamless pipe manufacturer in the United States. The company was organized to make seamless tubing and the first product was made on July 24, 1891, at Shelby, Ohio. The product was made for use in

bicycles, but was gradually broadened to include other mechanical uses.

The first step in making a seamless pipe is to put a hole through a heated round bar long enough to provide the material needed in the finished tube. This is done by a pair of rolls rotating on axes inclined slightly to the axis of the bar. Rotation of the rolls causes the bar to rotate and to travel lengthwise. A conical shaped mandrel is supported at a suitable position between the rolls and in the line of the axis of the bar. As the bar advances by the motion of the rolls, it reaches the mandrel and flows over and around it. Thus the solid bar is made into a pipe. The relation of the length and diameter of the bar to those of the pipe may be varied over a wide range to suit the size of pipe being made. The walls of the pipe, as it leaves the piercing mill, as the pair of rolls is called, are much thicker than is needed for pipe generally. The required thickness of the final product is secured by subsequent operations.

The practical problem of reducing the thickness of the walls of the pipe produced on the piercing mill to that required for economic use delayed utilization of the advantages of the seamless quality for many years. In Europe the Pilger mill was slowly developed for this purpose. In America, the rolling mill was selected as the more promising means. Rolling requires the piercing mills to produce much lighter walls than Pilgering. Thus the art of piercing was developed more rapidly here than abroad.

The converting of a round solid bar to a seamless pipe requires several operations. The operations are:

1. Pierce the solid round bar to tubular.
2. Roll the wall of the pierced pipe to the finished wall.
3. Smooth and finish the inside and outside surfaces.
4. Reduce to the finished diameter.

The sequence of operations limited the diameter of the pipe to approximately 14 in.

In 1928 National Tube Company introduced the rotary rolling operation between the second and third steps in the sequence. By this means the diameter range was greatly extended. The equipment is capable of producing diameters up to 24 in.

The rotary rolling process has made possible the production of large size thin wall seamless pipe.

Book Reviews

The American Society of Heating and Ventilating Engineers Guide—1937 Edition. Published by The A.S.H.V.E., 51 Madison Ave., New York, N. Y. Technical Data Section—808 pages arranged in 44 chapters. Catalog Data Section—316 pages. Size 6 x 9 inches. Flexible binding. Price $5.00.

This familiar and invaluable handbook has been substantially revised and enlarged to keep pace with the rapid developments in the fields which it covers.

Some of the changes and additions this year include: Recalculated tables for the properties of dry and saturated air, based on the instantaneous specific heats of air. The chapter, Physical and Physiological Principles of Air Conditioning, has been completely rewritten and covers the varied fundamental requirements, which must be considered in properly designing a system to satisfy human environments. Heat transmission coefficient tables have been amplified. Problems of humidification, dehumidification and water cooling are discussed in a new chapter. Mechanical draft cooling tower design factors are presented in tabular form with conversion factors corresponding to design wet-bulb temperature.

Other chapters, completely rewritten are Automatic Control, Sound Control, and Air Distribution, featuring the latest information obtainable. Other extensive revisions include the material on Gravity and Mechanical Warm Air Furnace Systems, Chimneys and Draft Calculations, Drying Systems, Refrigeration, Cooling Methods, Air Cleaning Devices, Railway Air Conditioning, Boilers, Radiators and Gravity Convectors, Steam Heating Systems, Hot Water Heating Systems and Piping, Electric Motors and Controls, etc.

A revised Bulkeley Psychrometric Chart with an additional directrix line is included. The popular feature, Problems in Practice, is continued.

All of the principal illustrations, curves and charts have been redrawn. The drawing symbols for heating, ventilating and air conditioning applications have been revised and amplified to include the piping and fitting symbols recommended by the *American Standards Association* for drafting room practice.

The Objective Rate Plan for Reducing the Price of Residential Electricity, by William F. Kennedy, Published by Columbia University Press, 2960 Broadway, New York, N. Y. April 19, 1937. 83 pages. Price $1.25.

This is a clear, able and impartial description and appraisal of the so-called objective rate plan.

The objective rate plan for residential electric service was introduced on October 1, 1933, by the Alabama Power Company, a subsidiary of the Commonwealth and Southern Corporation. Since then fifty-six other electric companies in thirty-three states a well as a number of gas companies have adopted residential schedules based on the principles of this plan. The plan has attracted nation-wide attention and has received the approval of a number of state regulatory commission.

The conclusions with which Mr. Kennedy closes his book will be of particular interest to the gas industry.

"The objective rate plan faces two dangers which are inherent in all differential pricing. One of these is that added plant might become necessary, the cost of which was not covered in the differential prices. This has happened in the case of freight rates. . . .

"The electric companies might encounter the same situation if consumers purchase energy at very low rates and use it for a purpose that incurs higher costs of service, such as unrestricted water heating. . . .

"A greater danger is the possibility that the widespread increase in the use of heavy-duty (electric) appliances, such as ranges, will necessitate expensive additions to the distribution system. . . .

"Differential pricing is often socially harmful when it diverts business from a producer who may be better suited economically to carry such business. . . . From this point of view it may be socially undesirable to divert domestic cooking and water heating from the gas industry. This problem can frequently be settled by encouraging the gas utility to install differential prices, thus putting itself on an equivalent competitive footing."

We commend this book to the executives and rate engineers of gas companies as well as to the corresponding staff members of electric utilities.

Yes, it's a Water Heater — believe it or not!

IT looks like a kitchen work table... but it's actually the new American-Bosch Kabinette Water Heater. Enclosed within its sleek, trim smartness, are heating unit, automatic controls, and the revolutionary ball tank of 20 gallon capacity.

The Kabinette casts aside all precedent in water heater design . . . modernizes it... brings it abreast of other kitchen conveniences in beauty and extra utility.

Its chromium-finish work top is table high... forming a working surface of even height with range, drain, table. And with these, too, its gleaming white enamel and black trim are in beauteous harmony. Yet it's low in price; low in operating cost.

Will it sell? *Will it!*

Size 36" high, 25" wide, 25" deep.

Situations Wanted

by these other gas salesmen—sponsored by American-Bosch.

American Bosch Konverto—converts the old-fashioned water heater into a modern automatic storage system.

American-Bosch No-Tank Water Heater—supplies automatic hot water, instantaneously, without a tank or hot water pipes.

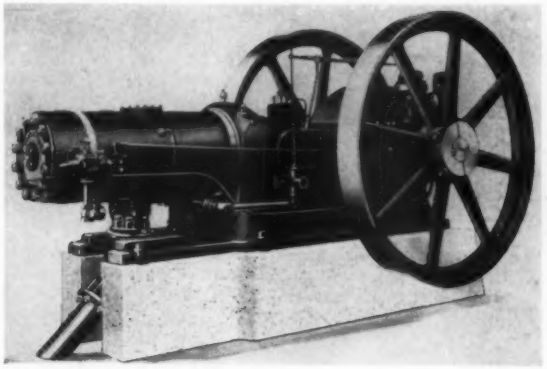
American-Bosch Ball-Tank Water Heater—the revolutionary automatic gas water heater with the globe-shaped tank.

AMERICAN-BOSCH KABINETTE

Gas Appliance Division: UNITED AMERICAN BOSCH CORPORATION, SPRINGFIELD, MASS., New York Boston Pittsburgh

The Future Load Building Possibilities of Gas Engines

By W. J. Briggle, Jr.
Industrial Department
Lone Star Gas Company

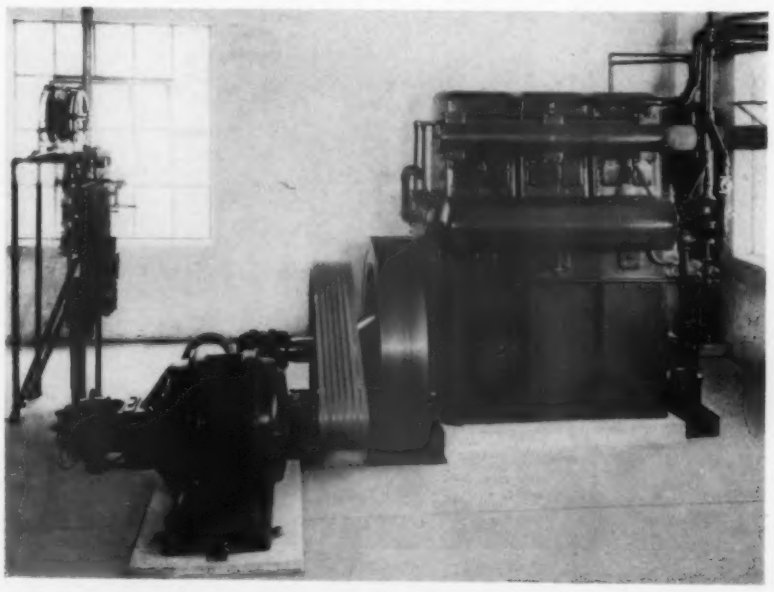


A Cooper-Bessemer 80 H. P. single-cylinder horizontal two-cycle type of gas engine similar to the one which has been operating in a Texas cotton gin for twenty-four years.

The successful and continued advance of civilization is practically dependent upon the increasing use of mechanical power. The requirements of our forefathers back through the ages were simple indeed, and could be sucessfully met with no greater effort than that of human strength. As time and the world progressed, knowledge also increased and greater demands for power arose. These were first met by animals, and then water and wind. For a time, these three units of power were sufficient. Then came a period where a reliable source of power was needed. Animals proved inadequate, moving wind uncertain, and water, while it can be made to furnish almost unlimited quantities of power and is today being used to generate hundred of thousands of horsepower, water power sites are not always conveniently located near industrial centers. This necessitated anther form of power, that of the conversion of heat energy into mechanical energy. Passing over the further developments of this type of energy and continuing into the realm of today's requirements, we will confine our facts and figures to gas engine power, its present status, and its future.

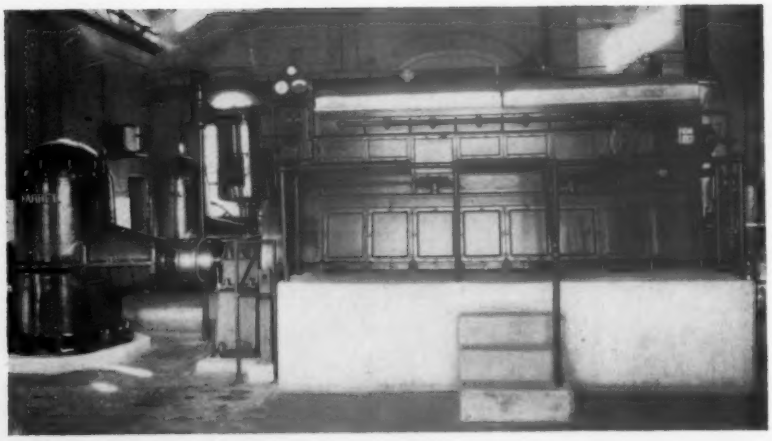
There can be found today numerous types of industry where gas engines are being utilized as means for furnishing power. These engines are being used as prime movers for both generator and line shaft drive. The Lone Star Gas System has over thirty different classifications of industry where gas engines are being used to generate and drive the power requirements. Included in these installations are the new and used automobile installations converted to the use of natural gas. The high speed automotive type stationery engine operating from 800 to 1200 R.P.M. The four cycle multi-cylinder vertical engine operating from 400 to 675 R.P.M. The four cycle multi-cylinder vertical type heavy duty engine operating from 225 to 300 R.P.M., and the four cycle single and twin cylinder also double acting twin tandem engine operating from 125 to 300 R.P.M. The numerous classifications of industry and the varied type of engines being used proves that the gas engine is taking its rightful place in the development of mechanical energy.

The oldest and most unusual industrial installation on the Lone Star Gas System is an 80 horsepower Bessemer two cycle gas engine operating at 180 R.P.M. This unit was purchased in 1913 by the operator of a cotton gin and has been in constant use since that time. The total cost of maintenance during these past twenty-four years has amounted to only $180.00. The average cost per bale of cotton ginned during a recent season amounted to the small sum of 21.8c. This included fuel and lubrication. This record is indeed remarkable and bespeaks well of both the manufacturer and the operator of this engine. On the Lone Star Gas System there are more than one-hundred cotton gins using gas engines for power. The fact has been definitely established that the ideal prime mover for a cotton gin is the gas engine. By reason of the low initial cost and economical operating results, the cotton gin industry is indeed a fertile field. It would be well for the gas companies in the cotton gin sectors to concentrate on the securing of this load to their lines.



Three-cylinder 110 H.P. gas engine driving a generator in a Texas garment factory.

Several years ago a large garment



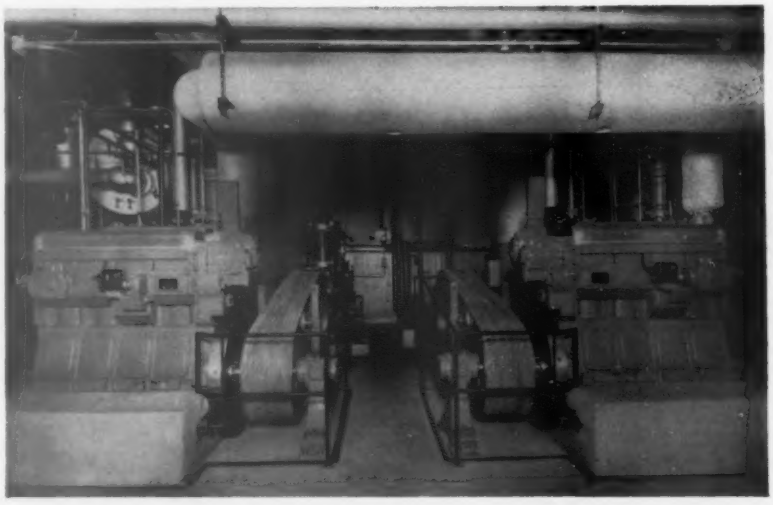
One of the gas engines which drive a sewage pump through angle gears for the City of Dallas, Texas. This engine built by Cooper-Bessemer is rated 400 H.P. at 400 r.p.m.

manufacturing plant in Texas was faced with an exceedingly high electric power bill which in turn was causing high production cost. After investigating several types of power they decided to install a gas engine. This was a Cooper-Bessemer, 110 horsepower, 300 R.P.M. four cycle 11½x14 gas engine, connected by V-belt to a 75 K.W., 220 Volt, three phase alternator. This installation takes care of all their power requirements. This unit has more than warranted its installation. The maintenance and operating cost have been exceedingly low. This has resulted in their production cost being reduced by 33⅓%. There is an exceedingly bright future for the gas industry in this type of manufacturing plant. They have good load factors and operate twelve months out of the year. In sections where gas is available, plants of this nature are numerous, it would be well to contact them closely. There is no doubt that hundreds of prospective customers using thousands of horsepower can be induced to use gas engines for their requirements by the right contact and the correct solution of their power problems. A gas engine installation can adequately and convincingly solve their problem of high power and production cost.

In the disposal plant of the City of Dallas, Texas, there are two engines in operation driving sewage pumps through right angle gears. The operation and results obtained from this installation has proved very gratifying to all concerned. There are numerous municipal power requirements that can be met successfully with gas engines. It is believed a far more concentrated effort should be made by the gas industry to secure this type of load.

The newest field opened to the gas industry for the use of gas engines for power requirements is that of air conditioning. Only recently, one of the largest mail order concerns in the South installed a gas engine driven air conditioning unit. The scope in this field is unlimited due to the fact that all types of business establishments are practically forced to keep step with the trend of modern times. Fuel requirements for this type of installation is during the summer season, and offers an outlet for the gas industry for their product during the off-peak season. The equipment now being offered for this type of service is modern and up-to-date, and the most exacting requirements can be satisfactorily obtained.

The highest commendation should be given to the manufacturers of natural gas engines and their engineers for their untiring efforts to give the industrial world equipment that is sound in principle, reliable in construction, and efficient in operation. It has been through the full hearted co-operation and enthusiastic response of various engine manufacturers with the Lone Star Gas System that we have been able in the last six years to increase our gas engine load from 22,000 horsepower to over 51,000 horsepower. During this period of time it has not been necessary for the company to make any material reduction in rates to attract this business to our lines. This desirable gas engine load has been secured by intensive sales work, and by sound engineering principles. Competitive fuels have long been a thorn in the side of the gas industry. It has been found that where an engine is installed the customer is reluctant to discard valuable equipment simply to take advantage of a possible day to day fluctuation in the price of other fuels. There are many advantages to be realized from the gas engine load aside from the revenue from this business. Selling the customer a service at an anticipated saving of from 35% to 75%, and then having this saving materialize is bound to return in dividends of good will from the general industrial and commercial world. The possibility of securing this load is entirely up to the co-operative efforts of the various engine manufacturing concerns and the gas industry. There is no doubt that the entire gas industry could benefit greatly by showing more interest and devoting more time to the promotion of gas engine sales. The way has been paved by the highest development of mechanical energy. It is now up to us to follow through with enthusiasm and sound sales effort.



Two 120 H.P. gas engines driving refrigerating compressors for air-conditioning the offices of a large mail order house in Texas.

HEATING BUNKER "C" OIL

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ANDALE BOWED TUBE HEATERS

remain tight and are easily cleaned. These are the requirements for continuous satisfactory operation.

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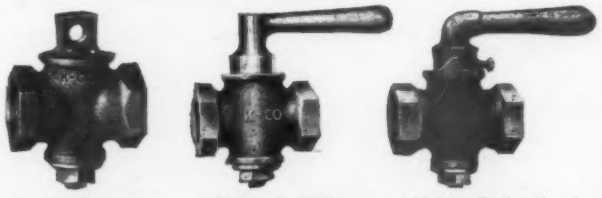

G-101—Flathead Special Gas Stop
G-207—Solid Lever Standard Gas Stop
G-210—Socket Head Standard Gas Stop

Stops illustrated, in sizes—
¼" ⅜" ½" ¾" 1"
1¼" 1½" 2"

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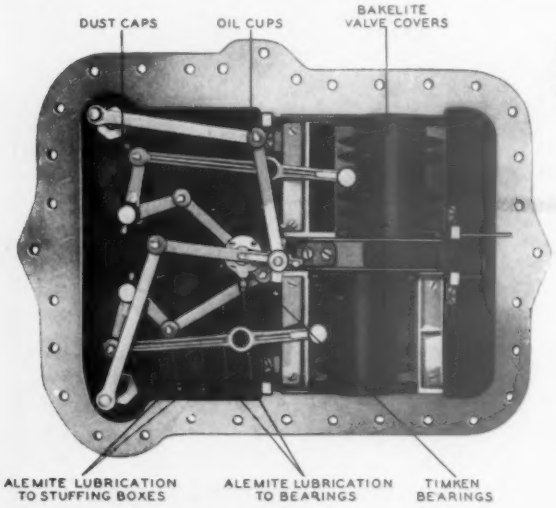
(Continued from page 32)

the gas, the temperature and the specific gravity. The gas time for one cubic foot index reading is equal to the standard air time (time required for the passage of one cubic foot of air at 60 degrees F. through the orifice) multiplied by factors depending upon the ratio of specific heats of the gas at the temperature and the specific gravity. Proof of the meter is equal to the test time divided by the correct time.

Pressure Integrator for Displacement Meters

This device registers a totalized reading, in cubic feet at base pressure, of the quantity of gas passed through the meter. Each hundred cubic feet is multiplied by the pressure factor which applies for the line pressure of the gas and the pressure base. The products are then totalized on a counter index in thousands of cubic feet. A supplementary index gives a reading of the actual quantity of gas in hundreds of cubic feet at line pressure. The Volume and Pressure Gage can be used with the index. Charts from this gage will serve as a permanent record of the rate of flow, and can be used as a check on the reading from the integrating index, if such procedure is desirable.



Valve Construction of Displacement Meter — Showing the Small Angular Movement of the Working Parts.

Pressure and Temperature Integrator for Positive Meters

This type of integrator registers a totalized reading of the quantity of gas passed through the meter, in standard cubic feet at base pressure and base temperature. Each hundred cubic feet of actual volume at line temperature and pressure is multiplied by the temperature factor which applies for the line temperature and the base temperature, and then by the pressure factor which applies for the line pressure and base pressure. An instrument of this type is the Base Volume Index.

Improvements in Displacement Meters

Mention should be made of the use of Bakelite valves, roller bearings and lubricated bearings. The Bakelite valve has proved especially advantageous because it is of light material, dissimilar to that of valve seats —thereby eliminating noise which may occur at valves, and providing a positive seal for a longer period of time, particularly in large high pressure meters. Large meters are subject to heavy loads. Lubrication of bearings and the extended use of roller bearings have proved of material benefit in reducing the initial friction of such meters. They increase the life of the bearings, and reduce wear and consequent play at joints.

Numerous changes have been made to increase the capacity and the life of all types of displacement meters. Special emphasis should be placed on those improvements which now smooth the path of flow through tinplate meters—so extensively used for indoor installations, on low pressure delivery. The utilization of longer wearing materials in bearings, and the increased capacities of meters in the same size of case, are of great significance. At present, the capacity of tinned steel-case meters in a 5-B case is as high as 250 cubic feet an hour, whereas only twenty-five years ago the maximum capacity of meters of the same size was approximately 90 cubic feet an hour.

A recent notable improvement has been the further advantage obtained by the use of soldered seal index boxes. In this new index box, the glass is soldered to the frame. The glass is a new application of the Pyrex brand, resistant to temperature changes. This index box assembly is gas-tight and positively leak-proof; unharmed by washing in cleaning solutions incidental to meter repair work. By its addition at a slightly higher initial cost, there is the added intangible value of better customer service and improved relations.

Iron Case Displacement Meter, Equipped with Base Pressure Index.

Change-over to Natural Gas in Indiana

Sixteen cities and towns served from the mains of the Public Service Company of Indiana will receive natural gas this summer, with the first change-over being made in Noblesville at midnight, May 3.

The Public Service Commission of Indiana has approved a contract between the company and the Michigan Gas Transmission Corporation for the purchase of natural gas from the latter company's pipe line which crosses Indiana in a northeasterly direction to Detroit. The commission also has approved the Public Service Company's rate schedules, which will be the same in each of the communities served.

The following schedule has been established for the change-over: Noblesville, May 3; Arcadia, Atlanta, Cicero and Tipton, by May 10; Lebanon and Ulen, May 17; Antioch, Mechanicsburg and Frankfort, by May 26; Crawfordsville, June 7; Romney, Linden, Attica and Williamsport, by June 18, and Lafayette, June 21. It is expected that the change-over will be completed in Lafayette by July 24. A deadline of August 1 has been set for completion of the entire program.

Special crews of change-over men now are being trained for the work. Approximately 15,000 meters are involved in the change-over. Last fall the company installed natural gas in New Castle for residential and commercial use. Natural gas previously had been available there only for industrial customers.

Construction crews of the Michigan Gas Transmission Corporation already have started work on the tie-in lines which will connect the main pipe-line at two points with the Public Service Company distribution system. One line, approximately 21 miles long, will be built north from the main pipe-line to Crawfordsville. The second tie-in, approximately 14 miles long, will connect at Lebanon. The longer line will be six-inch seamless, welded high-pressure pipe, and the line to Lebanon will be of four-inch capacity.

The Noblesville and Tipton section of the company's territory was chosen for the first activity because of the close proximity of these communities to the main Michigan Gas pipe-line. By the time the change-over of appliances has been completed in these towns, it is expected that the tie-in lines to Crawfordsville and Lebanon will have been completed.

New Natural Gas Lines

Cities Service Gas Co., 47-mile, 12-inch line from present line from Seminole to Ada, Okla.

El Paso Natural Gas Co., 8½-mile, 6-inch line to Hurley, N. M., from existing 5-inch line near White Water. 21-mile, 4-inch line from 12-inch main near Lorsburg, N. M., into Lorsburg, and 46-mile, 6-inch lateral from main 10-inch line near Redrock, Ariz., to Hayden, Ariz.

Cabot Gas Corp., 94 miles of 14-inch line from Potter County to Rochester, N. Y., and 24 miles of 12-inch line from the state line field to the Sabinsville field, New York.

New Directory of New England Manufacturers

A new revised edition of the Directory of New England Manufacturers has been recently issued with the editorial cooperation of the New England Council.

17,000 New England Manufacturers are listed, together with the names of the principal officers — President, Treasurer, Sales Manager and Purchasing Agent. Also a description of the product made, number of employees, capital and location of plants or branch offices.

In a second section, these same concerns are classified by state, city and town. This section is valuable for routing salesmen and mapping out sales campaigns as it shows where concerns in a particular line of business are located in any geographical area. A third section of the Directory lists all products alphabetically together with the names and addresses of the makers. There is also a Brand Name section which enables anyone who is familiar only with the brand name of a product to identify the maker. *Directory of New England Manufacturers, Published by: George D. Hall, Inc., 665 Boylston Street, Boston, Mass.*

Chace Thermostatic Bimetal is the active element used in the Multi-Breaker to automatically prevent overloading circuits. Multi-Breaker takes the place of fuse box and fuses, yet its cost is comparable to that of a switch with customary fuses.

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Sold in sheets — strips — shapes.

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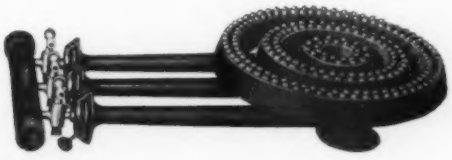

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Triple Atmospheric Ring Burner

This powerful, widely adaptable burner is made up of three independent concentric burners. Each burner is individually controlled and the unit can be used singly, in pairs or in triple. The valves are equipped with the Johnson Patented Direct Jet Regulator with adjustable hood cap and each ring burner has a separate Johnson Venturi Mixer and Tube with heavy A.G.A. Type Valve. The burners are constructed to allow plenty of secondary air to each burner flame, adding efficiency and longer life. An outstanding unit in every respect. Write for free catalog.

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250 Stuart Street
Boston, Mass.

(Continued from page 55)

not "swept" through this volume, actually passing less gas than registered. Conversely, if the parts of the meter which limit the stroke of the diaphragm permit the diaphragm to move through a longer stroke than intended the meter will register slow. From these facts we see immediately that the design of the meter should be such that under all conditions of operation the diaphragm should stop and reverse its motion at exactly the same point each cycle. This would seem to be a simple thing to do but actually it is more difficult than it seems, as a further study will show.

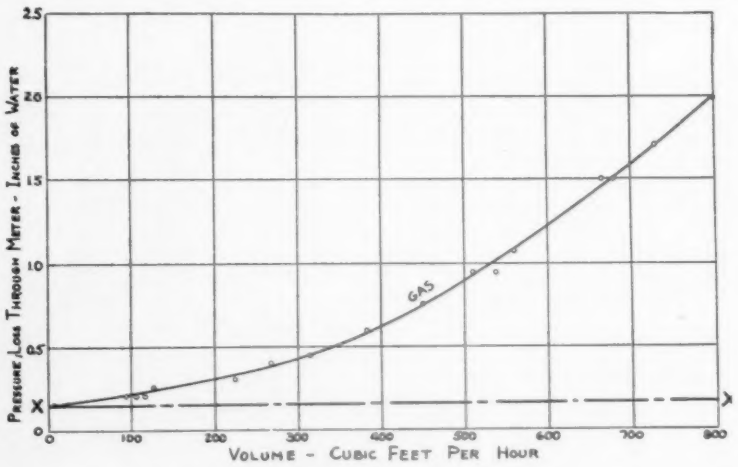


Fig. IV. Pressure Loss in a Gas Meter.

There are two obvious factors which we can see influence diaphragm stroke. One is wear and deflection in those parts, from the tangent down to the diaphragm disc, which guide the stroke. If our tangent bushing wears, if any of the supporting bearings in the mechanism wear, this wear is taken up and a longer diaphragm stroke permitted. Similarly, if any of the parts deflect, such as the flag rod in torsion, or the flag in bending, a longer diaphragm movement results with increased displacement, and a slow meter.

The other obvious factor is the stiffening or shrinkage of the diaphragm. If for reasons, due to the chemistry of the gas, the leather composing the diaphragm shrinks excessively, it will tend to limit the free stroke of the diaphragm disc, causing a short stroke. Change in stiffness, or resistance to bending is another leather attribute which affects diaphragm stroke; this seems like a rather small force, but when we realize that the forces which cause the diaphragm stroke are also small, change in stiffness can be considered important. It is a very difficult force to measure, but we do know that leather stiffness does affect proof.

There is still another factor affecting displacement and this one is not so obvious. The diaphragm goes to the end of its stroke, because of two forces. One is the difference in gas pressure existing across the diaphragm disc, and the other is the fact that while one diaphragm approaches the end of its sroke, the opposite diaphragm is at a position where it can exert a large force through the tangent to force the first one to the end of its stroke. Any factor causing a change in pressure difference at the end of the stroke will change the force which tends to drive the diaphragm to the full completion of its stroke and hence a change in displacement.

This matter of pressure difference across the diaphragm we find is really a matter of importance. In larger meters, and in meters designed to measure gas at the higher pressure ranges, this pressure difference is of a large magnitude; while not so great in domestic meters, it is nevertheless important from the point of view of accuracy. It is of enough importance for us to digress at this point to study the entire matter of pressure loss through the meter.

If we should place an ordinary meter on a test whereby we could accurately measure the pressure loss, by means of say a slope gauge, and plot this loss of pressure against the rate of flow, we could get a curve such as shown in Figure IV. It will be noted that as the rate of flow increases, the pressure loss increases with a curve that tends to rise at an increasing rate (convex upward). At the zero rate of flow position the curve crosses the ordinate line at a value considerably above zero. This means that a certain initial pressure is required to overcome the static mechanical friction and start the meter. It is very probable that for the ranges of speed we encounter in meter work, the force of mechanical friction does not increase much as the speed (rate of flow) increases, except at the valves. However, we know from the laws governing the rate of flow of gas through restrictions, that as we increase the rate of flow, the pressure loss increases as the square of the rate of flow. Now, the meter is a series of restrictions, one of them, the valve opening being a valuable restriction, and so with an increasing flow rate, in each passage through the meter, there will be an increasing pressure loss. This is reflected in the fact our curve raises upward rapidly.

The pressure loss as shown in Figure IV is the total loss across the meter, and as such is interesting to the distribution man since it has some effect on the pressure at the appliances. Our immediate concern, however, is the pressure loss across certain internal parts of the meter. We have seen that the diaphragm stroke can be subjected to certain variations and if we consider this, any variation in pressure difference across the diaphragm disc at the end of the stroke must be multiplied by the area of the disc, we realize that there may be a relatively large force variation which influences the extreme position of the disc. And we have seen that variations of this end position affect accuracy.

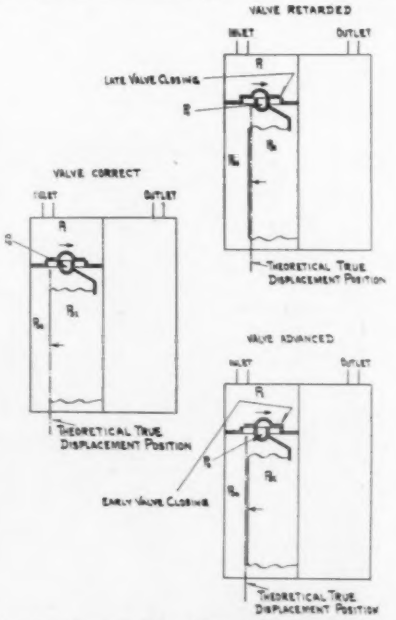


Fig. V. Pressure in a Meter During Operation.

In Figure V we see the diaphragm just before it reaches the end of its

stroke and for the position this valve should just be approaching, a position which cuts the diaphragm chamber off from both inlet and outlet connections. The inlet pressure we have noted by P_I, the pressure of the inner side of the diaphragm disc by P_{DI}, on the outer side by P_{DO}, and at the outlet, by P_O. $P_I—P_O$ is obviously the overall pressure loss across the meter. $P_I—P_{DI}$ is the pressure loss through the valve due to flow of inlet gas; $P_{DO}—P_O$ is the pressure loss through the D of the valve of the gas passing to the outlet. $P_{DI}—P_{DO}$ is the force however we are interested in and is applied directly across the diaphragm disc. Any variation in $P_{DI}—P_{DO}$ will result in some change in displacement, hence some change in proof.

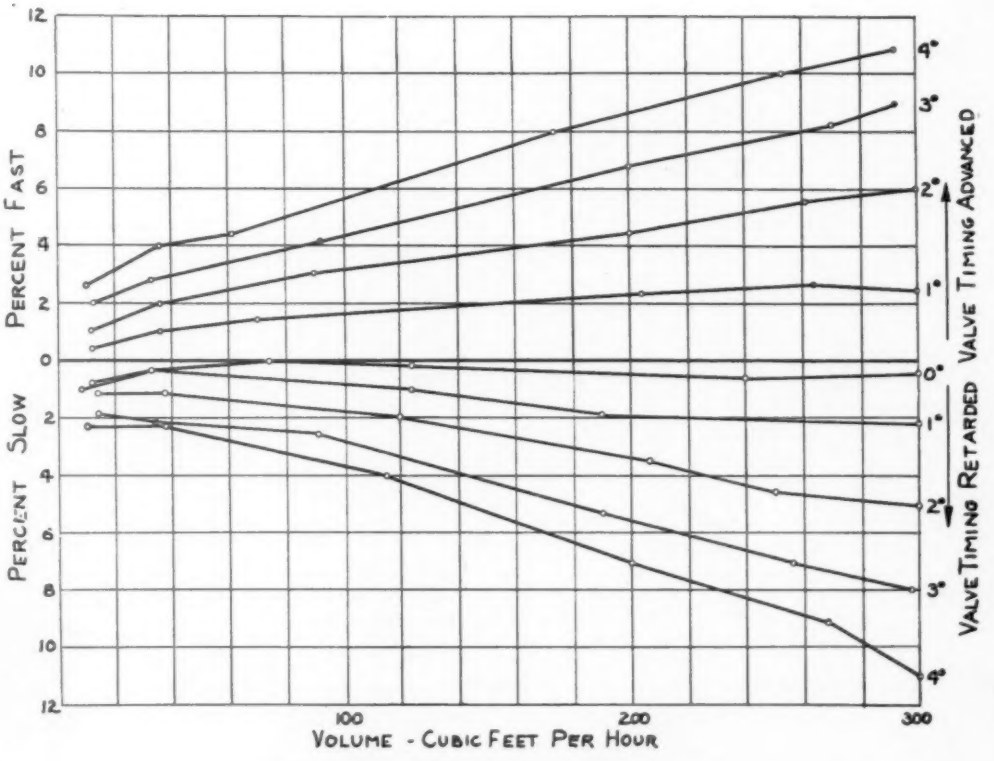


Fig. VI. Effect of Valve Timing on Meter Accuracy.

Let us suppose that for some reason we arranged the timing of the valve so that it was retarded, i.e., late with respect to diaphragm position. This position is shown at the upper right hand of Figure V. Thus the orifice caused by this valve is larger and the pressure losses $P_I — P_{DI}$ and $P_{DO} — P_O$ are smaller. But $P_I — P_O$ is approximately the same for any given rate of flow through the meter. Hence we have increased $P_{DI} — P_{DO}$ by retarding the valve. This increased difference in pressure will cause a somewhat longer extension of the diaphragm and diaphragm disc at the end of the stroke with a resulting slow meter.

Now instead of retarding the valves, we advance them, i.e., cause them to close early with respect to the diaphragm position. This arrangement is shown at the lower right of Figure V. Here since we have cut the supply of inlet gas before the diaphragm has actually reached the end of its stroke, we have a somewhat different situation. We must remember that the opposite diaphragm is at the very center of its stroke, its point of maximum driving power, and it will, due to the fact that it is connected to the same tangent mechanism try to force the first diaphragm (which we are studying) to its stroke's end. Now what happens to our pressure? P_{DI} was somewhat lower than P_I at the time of cut off, due to pressure loss through the valve. Any attempt to move this diaphragm will result in trying to increase the volume of the space when the pressure P_{DI} exists and we will have decreasing value for P_{DI}. By similar reasoning we will have a tendency to increase P_{DO}. If the valve cut-off is moved far enough ahead it is possible to cause P_{DI} to decrease to a point where it is momentarily lower than P_O. These forces tend to keep the diaphragm from making its full stroke and results in a fast meter.

The overall pressure loss $P_I — P_O$ we have seen from Figure IV increases with increasing rate of flow. We would assume then that for the position of valves retarded the difference $P_{DI} — P_{DO}$ would also be greater at higher rates of flow than at low, and the diaphragm movement somewhat greater, resulting in a slower meter at high rates of flow.

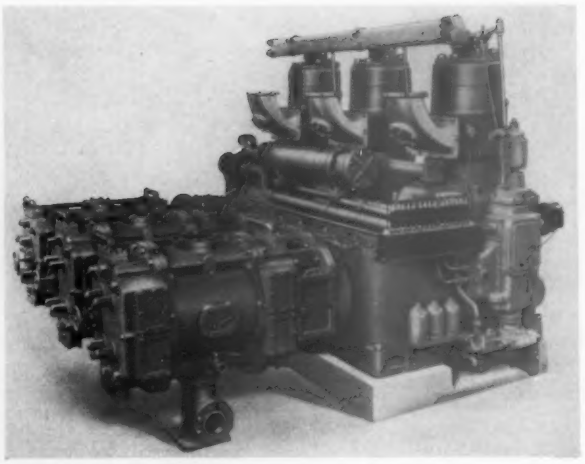
Similarly for the position of the valves advanced the $P_I — P_{DI}$ increases as the rate of flow increases and at the time of shut-off, P_{DI} is lower at high rates of flow, causing an increased tendency to short stroke with a resulting fast meter, one which would be faster at the high rates of flow than at the low.

If we actually run proof curves on our meter, with the valves intentionally set retarded or advanced, we get a series of curves shown in Figure VI, which we see on examination bears out our theoretical deduction. In this series of curves we plot meter accuracy against rate of flow. At the right of each curve there is a notation as to valve timing, i.e., the angle of valve timing around the tangent arc, with respect to the diaphragm, either in advance or retard. The 0° position is with the valves set theoretically correct. The 1° slow means valve timing retarded one degree with respect to the diaphragm, 1° fast means valve timing advanced one degree with respect to the diaphragm.

It will be noted that with the valve retarded one degree, the meter is 2% slow at 300 cubic feet per hour, and approximately ½% slow at 60 cubic feet per hour. But if we retard the valves to 3°, the slow percentage is 8% at 300 ft. and but slightly over 2% at 60. When we advance the valves say 2°, the result is a 6% fast error at 300 ft. an hour, and 3% fast at 60 ft. per hour.

(Continued in June issue)

New Equipment



Cooper - Bessemer Type G-MR-3 two-cycle Angle Compressor Unit, rated 225 H.P.

Cooper-Bessemer Builds an Angle Compressor Unit

The Cooper-Bessemer Corporation, heretofore builders of compressor units of both the horizontal and vertical types, report the satisfactory conclusion of long tests on a combination vertical gas engine and horizontal compressor — an "angle" compressor unit—of advanced design, by which the ruggedness and dependability of the approved horizontal unit are in great measure retained, along with the compactness, quick installation, and low initial installed cost afforded by the new departure.

This angle unit, to be known as Type G-MR, is of two-cycle design, having two, three, or four power cylinders according to requirement, the rated horsepower being 75 for each cylinder and ranging, therefore, from 150 to 300 H.P. The unit is factory-assembled and tested and is so constructed, with all power and compressor cylinders rigidly attached to a common base, that it can be shipped by rail or truck without fear of disturbing the alignment of any part. Arriving at the site, it can be set down on its prepared foundation and is almost immediately ready to operate.

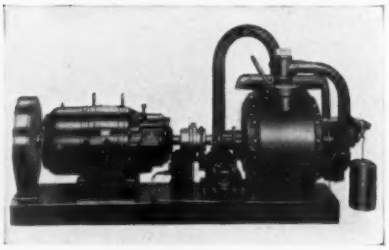
One other advantage announced is that the engine will be convertible from gas to oil or oil to gas fuel at any time after installation.

A wide range of usefulness is foreseen by the builders of this angle compressor—in booster stations, gasoline plants, refineries, gas-lift or repressuring operations, refrigeration service, and other special applications where the power requirements match the available sizes.

Air-Cooled Gas Booster

A new type of air-cooled gas booster suitable for countinuous service has recently been developed by engineers of Lammert & Mann Co., 221 North Wood Street, Chicago.

While heretofore the air-cooled type has been limited to light or intermittent service, it is claimed that the Lammert booster cuts power cost, runs cool, quiet and without vibration, making water cooling unnecessary even for heavy duty. Maintenance of steady pressure at high or light load is accomplished by the Lammert compensator.



Lammert Booster.

This unit requires no foundation and is adapted to portable use. It is equipped with forced-feed lubrication and oil separator.

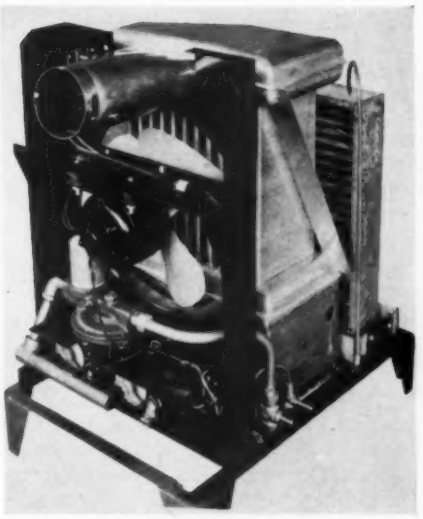
Fulton Regulator.

Cut-Out Latch Regulator

In the modern gas burner installation, safety and elimination of fire hazards are just as important as accurate regulation of the gas pressure. Reduction of fire hazards usually results in a reduction in the cost of insurance. The Fulton Cut-Out Latch Regulator was designed to meet this requirement.

The purpose of this regulator is to stop the flow of gas through the body when the pressure on the diaphragm falls to a given point. It is provided with a cut-out latch, which automatically holds the valve to its seat, when the pressure on the diaphragm fails. It is used principally in connection with low pressure burners and furnaces where it is desired to protect the equipment against hazards due to failure of the gas supply. Should such a condition exist or the gas pressure drop below a predetermined point, the function of this regulator is to shut off, immediately, the supply of gas to the burners and at the same time lock the valve in such a manner that the gas cannot be turned on at the burners, without the operator going to the valve and opening it by hand. The Chaplin-Fulton Mfg. Co., 28 Penn Ave., Pittsburgh, Pa.

and Appliances



Trane Company Heater

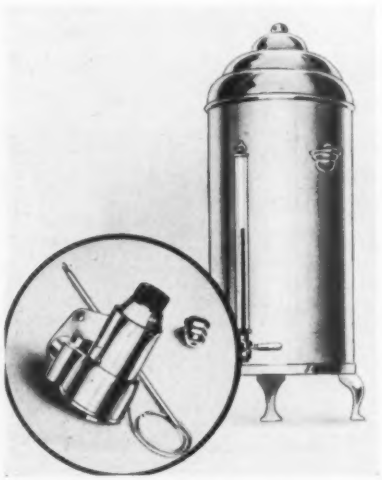
The Trane Company of La Crosse, Wisconsin, claim for their "Floorflo" Heater an 85% heating efficiency, complete automatic control, reduced fuel bills, proper distribution of heat, ease of installation, and positive safety. The unit is particularly adaptable for homes, apartments, stores, offices and factories.

The working parts consist of an all aluminum heat exchanger, burners, a safety pilot control valve, gas pressure regulator, and automatic supply valve, fans, motors, solenoid control valve, and a limit control switch. An automatic pilot switch prevents opening of the gas valve in the event of power failure. Has A.G.A. approval. Smallest size unit has 35,000 B.T.U. capacity.

The cabinet is designed to resemble a piece of furniture, but the same unit without legs is made in suspended type for store and industrial installations. May be equipped with humidifiers if desired.

Thermostat for Coffee Urns

A thermostat of improved design for gas-heated coffee urns, which is claimed to save from ten to twenty percent on the cost of operating such urns, is now being marketed by the Robertshaw Thermostat Co., Youngwood, Pa. The new controls can be obtained as standard equipment on new urns and are also available for easy installations on urns now in use, the company states.



A close-up of the new Robertshaw thermostat for coffee urns. The flexible tube shown in the circle is inserted in the urn. The thermostat itself is bolted to the frame.

The device regulates the flow of gas to the urn burner and can be set to control the temperature of the urn to the ideal temperature for brewing coffee and preserving its flavor and aroma over long periods of time. It also is claimed that the new thermostat prevents the boiling of coffee and the generating of steam which is wasteful of both fuel and coffee. The flavor of coffee is actually said to be enhanced by the more scientific and uniform brewing possible in urns equipped with this control.

The Robertshaw Company is also offering this new control in models for steam-heated urns and for other equipment such as steamtables, bake ovens, rinse tanks, deep fat fryers and gas range ovens.

New Silex Astoria Model For Use With Gas

A compact glass coffee maker, with built-in hot water heater, has been developed by the Silex Company. In a space just 14 inches square is a two unit glass coffee maker, a hot water tank, and warm storage space for two additional decanters of coffee. Here, in one compact unit, is all the equipment necessary for preparing all the better tasting coffee the small restaurant or soda fountain will serve.

The water tank, made of Monel Metal, has a capacity ample for the coffee brewing output. The tank is equipped with a quick-action float control, eliminating a water gauge. On the top of the tank are depressions to accommodate the two decanters used for storing warm coffee.

The range of the Astoria Model is chrome-plated steel. The top is finished in baked-on porcelain enamel. Both burners are combination high and low heat. The Astoria comes equipped with Pyrex brand glass exclusively.

More detailed information may be secured from the Silex Company, Hartford, Connecticut.

New Thermostat

An attractive thermostat, modern in design, is announced by General Controls under the trade name of the "Metrotherm." The new thermostat is of low thermal inertia and contains a small rheostat for adjusting the amount of heat acceleration. Maximum sensitivity to small temperature change is said to be obtained.

The design of the soft silver finished case is simple and graceful —two needle-like indicators show the temperature setting and actual room temperature on a modern dial.

Locking device standard. Available with timer. A new booklet concerning this instrument may be had by writing the manufacturer at 1370 Harrison St., San Francisco, Calif.

Mrs. Adams Serves as Chairman

Mrs. B. C. Adams, wife of the vice-president and general manager of The Gas Service Company in Kansas City, Mo., is serving as chairman of the Ladies' Entertainment Committee for the Natural Gas Convention.

Mrs. Adams and her committee have planned a most enjoyable entertainment program for the wives of gas men who attend the convention and any lady executives or employees who come to Kansas City.

On Tuesday afternoon, May 11, the ladies will take an auto trip and see some interesting highlights in Kansas City, the trip ending at the beautiful Nelson Gallery of Art where there will be plenty of time to visit this unusual exhibit. Tea will be served the ladies during their stay at the art gallery.

On Wednesday afternoon, May 12, the committee has planned a bridge luncheon which will be held at the Kansas City Country Club, one of the foremost country clubs of the country.

Everything possible will be done by the Ladies' Entertainment Committee to make the stay of the visiting ladies a most enjoyable one.

Home Service Breakfast

All gas company home service ladies are invited to attend a home service breakfast to be held on Thursday morning, May 13, at 8:30, in the tea room at the Hotel Muehlebach. The home service ladies are urged to purchase their tickets before 5 P.M., Wednesday, May 12, at the registration desk in the municipal auditorium. Tickets for the breakfast are $1.25.

MRS. B. C. ADAMS

Following the breakfast a short meeting will be held with Miss Jessie McQueen of the American Gas Association of New York, presiding. The program follows:

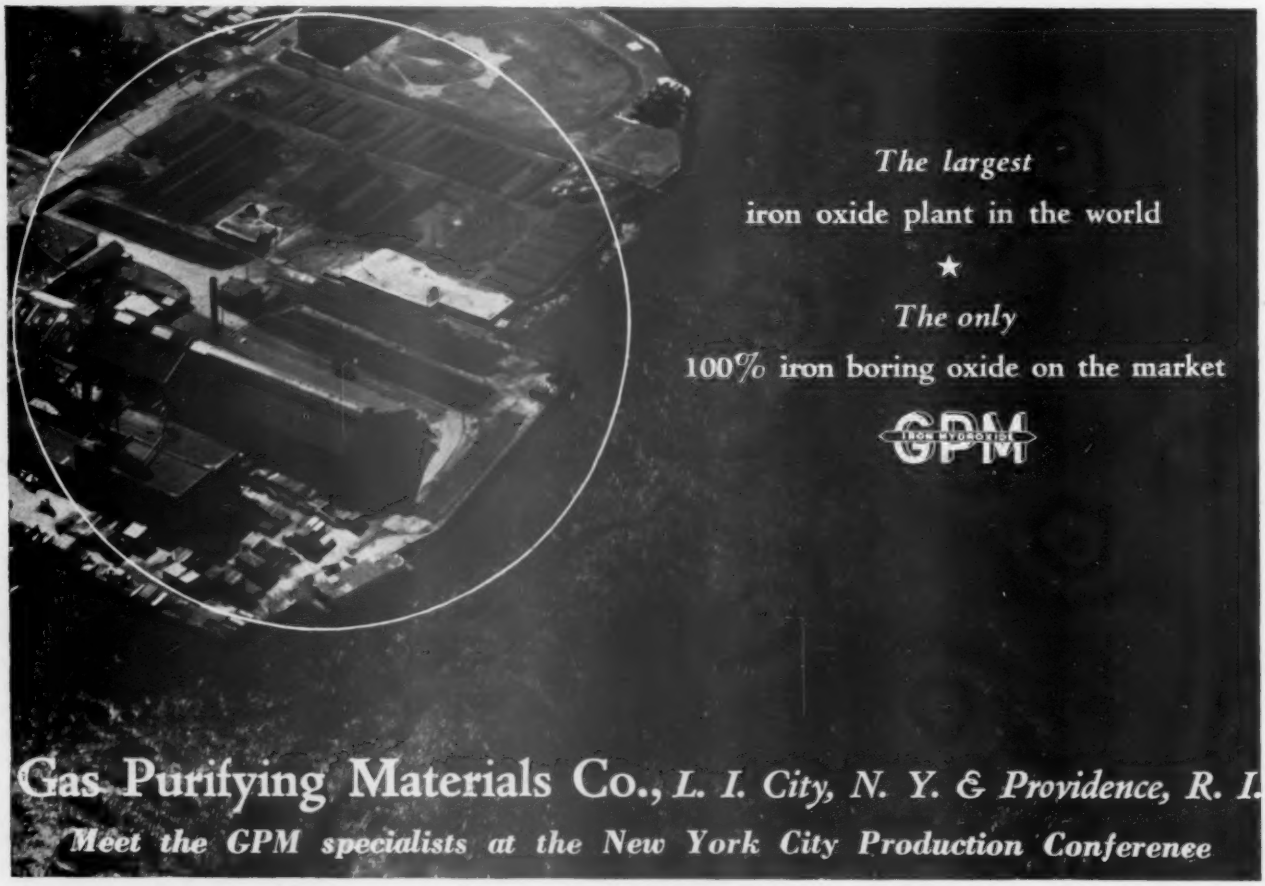
Greetings—Association Officers: Herman Russell, President; Alexander Forward, Managing Director; G. E. Welker, Chairman, Natural Gas Department.

Home Service Sells Natural Gas—Mildred R. Clark, Oklahoma Natural Gas Co., Tulsa, Okla.

Symposium: Two Minute Talks:

1. Gas Hospitality House—
   Mrs. Vera C. Ault, Public Service Company of Colorado, Denver, Colo.
2. Home Demonstrations—
   Betty Boyle, The Gas Service Company, Kansas City, Mo.
3. Our Special Attention to New Range Users—
   Mrs. Mary Louise Hurster, The Laclede Gas Light Co., St. Louis, Mo.
4. Amusing Interludes in Electrolux Promotion—
   Jane Tiffany Wagner, Servel, Inc., New York, N. Y.

A Sales Manager Views Home Calls—C. B. Wilson, Arkansas-Louisiana Gas Co., Little Rock, Ark.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Meet the GPM specialists at the New York City Production Conference

News of the Industry

Midwest Industrial Gas Sales Council

The meeting of the Midwest Industrial Gas Sales Council was held at Hotel Roberts, Muncie, Indiana on Friday, April 30 immediately after the meeting of the Indiana Gas Association.

It opened at 10:00 A.M. Friday, with a short address of welcome by the incoming President of the Indiana Gas Association. Mr. Frank T. Rainey of the Ohio Fuel Company was the speaker of the day.

After lunch an inspection trip tour of the Owens-Illinois Glass Company was made to see the manufacture of the new glass building block, then through a part of Ball Brothers manufacturing plant. Next the party visited Chevrolet's transmission plant where every conceivable kind of heat treating equipment was in operation and from there to the Delco-Remey Battery Plant. The fuel used in all cases is natural gas.

Departing from the usual scheme of meetings, Rodney G. Hayler of the Central Indiana Gas Co., went to great lengths to make this an unusually interesting one.

New 30 Year Franchise for Kansas City Gas Co.

The city council in Kansas City, Mo., on March 29, granted a new 30-year natural gas franchise to the Kansas City Gas Company. The vote of the council was 7 to 1. The former 30-year franchise of the Kansas City Gas Company, granted in 1906, expired in the fall of last year.

There are only two major provisions in the new franchise different from the former one. Rate schedules are not provided in the new franchise since the power to fix and regulate utility rates now is vested solely in the Public Service Commission of the state. Operating under the former franchise the company paid a franchise tax of 2 per cent on the gross receipts from the sale of all gas. The new franchise provides for a 2½ per cent tax on the sale of domestic and commercial gas, with industrial gas excluded from the tax.

The change in the tax was made to permit the sale of gas for industrial purposes in competition with other types of fuel.

Natural Gas for Noblesville

The Noblesville (Ind.) city council has signed a contract with the Noblesville Gas Company for natural gas to be provided by the Public Service Company of Indiana in accordance with a contract recently made with the Michigan Gas Transmission Company. Under the contract gas of 1,000 B.t.u. quality will be provided on rates comparable with those that now prevail for 570 B.t.u. artificial gas. Noblesville is the first of seventeen central Indiana communities that plan such action to sign a contract.

Laclede Gas Light Co. Elects New Board

Six St. Louisians were appointed to the Board of Directors of The Laclede Gas Light Company in addition to five members who were re-elected. The action was taken at a stockholders meeting April 2nd. The St. Louisians elected, none of whom was a member of the old Board, are: L. Wade Childress, A. Wessel Shapleigh, W. C. D'Arcy, E. E. Pershall, John Duncan, and Ben F. Pickard, who was named operating executive of Laclede Gas after E. P. Gosling, former president, resigned last December.

Other members of the Board, who served on the former body and were re-elected are: Phillips B. Shaw of Toledo, Ohio; M. E. Feiwell of Chicago; Archibald L. Jackson of New York, and R. R. Monroe and Walter A. Horner, who are executive vice-president and secretary, respectively, of Utilities Power & Light.

CONVENTION CALENDAR

May

4-6—Pennsylvania Gas Association, Sky Top Lodge, Sky Top, Pa.

10-15—Natural Gas Department, American Gas Association, Kansas City, Mo.

24-26—American Gas Association Production and Chemical Conference, New York, N. Y.

June

8-9—American Gas Ass'n, Industrial Gas Section, Industrial Gas Sales Conference, Chicago, Ill.

10-11—Canadian Gas Association, annual convention, Chateau Laurier Hotel, Ottawa, Canada.

11-16—International Gas Union, Paris, France.

24-26—American Society of Heating and Ventilating Engineers, New Ocean House, Swampscott, Mass.

June 28-July 2—American Society for Testing Materials, Waldorf-Astoria Hotel, New York, N. Y.

July

1-3—Michigan Gas Association, Grand Hotel, Mackinac Island, Mich.

September

Week of 27th—American Gas Association, annual convention, Cleveland, O.

Free Trips to Cleveland Convention Offered as Prizes

Six sales representatives of The Gas Service Company, Kansas City, Mo., will receive free trips to the annual convention of the American Gas Association which will be held the week of September 27 at Cleveland, Ohio, according to an announcement by F. M. Rosenkrans, new business manager. These free trips will be the result of an unusual prize award set-up in a two-months' water heater campaign which got under way April 1. The first part of the campaign closed April 30 and the second part will be held in June.

During the campaign a point system has been arranged with 10 points being allowed for the direct sale of each automatic storage water heater, 5 points for the sale of each water heater already on the lines under the rental plan, and 3 points for the renting of a water heater. All new business salesmen, including floor salesmen, who have 200 or more points total for the two-months' campaign are to receive gold watches, with the exception of the six salesmen winning the convention trip.

More points are being allowed on the direct sale of water heaters than for the rental of equipment in line with the policy of the company of gradually reducing the volume of rented equipment on its lines. It is believed that, with 36-month terms on time payment accounts, most installations can be made on the regular sales contract rather than the rental contract.

While this is not the first time trips to the A. G. A. convention have been awarded to prize contest winners, it is the first time the convention has been held in Cleveland, the site of the A. G. A. Testing Laboratories. The opportunity for inspecting the appliance testing and research program conducted there in addition to the many other convention attractions, should prove an added incentive to salesmen participating in the contest.

Approves Utility Merger

The California Railroad Commission has approved the merger of the Los Angeles Gas and Electric Corporation into the Southern California Gas Company in the manner asked by the companies in an amended petition.

According to the terms of the merger, the $100-par preferred stock of Los Angeles Gas and Electric will be exchanged, one share for four shares of $25-par 6 per cent preferred stock of Southern California Gas, and for each common share of Los Angeles Gas and Electric, four common shares of Southern California Gas will be given.

The merger is the result of the sale of electric properties of Los Angeles Gas and Electric to the city of Los Angeles last January.

Cooperative Sales Plan

Consolidated Edison Company of New York, Inc., announced on April 21, that effective July 1 it will discontinue the sale of domestic gas ranges. The display, demonstration, and taking of orders for approved merchandise will be continued under the Cooperative Merchandising Plan now in effect.

The Cooperative Merchandising Plan which was designed to increase the sale of appliances by dealers was started by the former New York Edison Company and the United Electric Light and Power Company in May, 1935, and continued by the Consolidated Edison Company. Up to that time, and since 1933 when the electric companies ended the practice of selling directly to customers, they had been engaged in a program of appliance sales promotion which included the turning over of leads to dealers to complete the sale. Under the new cooperative plan begun in 1935, the companies began taking orders for merchandise and transmitting the orders to approved local dealers through manufacturers without accepting any part of the purchase price of appliances sold, leaving all financial transactions, whether on cash or deferred payment sales, to be handled by the dealer who fills the order. This is the plan which is now in effect and under which domestic gas ranges will be merchandised. It is restricted to appliance dealers of high standing and limited to the sales of standard approved appliances.

In announcing the inclusion of domestic gas ranges in the Cooperative Merchandising Plan, E. F. Jeffe, vice-president in charge of sales, said: "It is our belief that material benefits will accrue to the industry as a whole in this territory as a result of the proposed change. The Consolidated Edison Company offers its full cooperation to manufacturers in the establishment of proper dealer outlets, in demonstrations, in the display, and in the sale of approved domestic gas ranges in accordance with our Cooperative Merchandising Plan."

George H. Baird Named Manager of Cities Service Gas Co.

George H. Baird has been appointed manager of the Cities Service Gas Company, it has been announced in Bartlesville by H. R. Straight, vice-president and general manager of The Empire Companies.

Mr. Baird has been employed at The Empire Companies in various capacities for 21 years, having started with that organization as a meter tester. For a number of years Mr. Baird has been general superintendent of the Cities Service Gas Company.

Ira E. Baker Co., Cleveland, Ohio, manufacturers of gas heating equipment and controls, have acquired new and larger premises for their factory and office at 4400 Perkins Ave., a property formerly occupied by Metals Welding Co. and United District Heating Co.

Dinner to Francis Engel

Commemorating his sixty-fifth year of active and continuous service with Elizabethtown Consolidated Gas Company of Elizabeth, N. J., Francis Engel, Vice-President and Secretary of the Company was tendered a testimonial dinner by his associates on April 13th. The following tribute on the program expresses the appreciation of his coworkers:

"We honor him for his continued and faithful service to his company, for his untiring effort in advancing both his company and the gas industry as a whole, for his vision in anticipating the changing position of gas in our ever changing economic and social structure, for meeting and solving the manifold problems of the industry, for his helpfulness and kindliness toward his associates, for his unselfish interest and active participation in civic affairs, and lastly and most particularly for his sterling character and personal qualities which endear him to all who know him."

FRANCIS ENGEL

Among the speakers were Hon. Hamilton F. Kean, Hon. Joseph A. Brophy, Mayor of Elizabeth; Henry Kreh, Jr., President, Chamber of Commerce, and John Kean, President of the Company. Thirty-two of those present have seen upwards of twenty-five years' service with their Company, and each were presented with gold buttons. Mr. Engel was presented with a gold watch by his fellow employees of whom two hundred attended the dinner.

Bailey Meter Co., Cleveland, Ohio, has issued new bulletins Nos. 15, 163, 194 and 301, describing the general line of Bailey products, Bailey Multi-Pointer Gages of the diaphragm-operated type, Bailey Synchro-Meters, and Bailey Fluid Meters for steam, liquids and gases.

Volume Sales Needed, Declares C. E. Paige

Volume sales of gas are needed now more than ever before, according to President Clifford E. Paige of the Brooklyn Union Gas Co., who addressed a group of 190 supervisory employees recently at the second of two sales plan luncheons which are held in connection with the anniversary of the Employee Sales Plan.

He stated that volume sales are required to offset losses and expenses. The losses are due to the new low gas rates and the increased efficiency of modern gas appliances. Increases in expenses will be felt this year in the price of coal and oil, in taxes and in costs incidental to extension of service.

The effort to build up greater sales is indicated by the domestic appliance sales quota of the New Business Department for 1937. This year the domestic appliance sales quota is $3,165,000. This sum is divided into $1,300,000 for house heating, $990,000 for refrigeration, $465,000 for cooking, and $410,000 for water heating.

This is an ambitious program, Mr. Paige told those present. It comes immediately after the year in which the greatest volume of gas appliances was sold by the company. During 1936 appliance sales showed increases all along the line.

Considerable aid in maintaining appliance sales at a high volume during the past several years has been given by employees through the Employee Sales Plan, the results of which, Mr. Paige declared, are a marvelous and spontaneous indication of company spirit.

Water Heating Costs

The Portland Gas and Coke Company, Portland, Ore., has issued a bulletin on waterheating costs based on the tests conducted by Prof. G. B. Wilkes at the Massachusetts Institute of Technology. The gas used by a gas water heater such as would normally be used in a six room residence occupied by 5 people (supplying 50 gallons per day, or 1500 gallons per month) would vary from 3250 to 3560 cubic feet per month according to the three heaters tested. At Portland rates (76c per Mcf) this would cost from $2.71 to $2.94 per month. The same hot water usage produced by two popular 2KW electric water heaters would result in consumption of 426 and 491 Kwh respectively which at 8 mills per Kwh would cost $3.42 and $3.93 per month. Portland gas averages 570 Btu.

The same tests have been used to make a comparison between gas and electric costs in Los Angeles where 1120 Btu natural gas is served. Here it was found that from 300 to 450 Kwh per month would be consumed per water heater according to the size of the family, this corresponding to 1275 to 1913 cu. ft. of 1120 Btu gas. With gas at 70 cents and electricity at 7.5 mills the cost ratio would be 2.52 to 1 in favor of gas.

CONGRATULATIONS to the Gas Producers and Gas Appliance Manufacturers for the magnificent attainments in their respective fields as evidenced at the Natural Gas Convention at Kansas City.

BEST wishes for a continuance of the forward strides which you have made in the Natural Gas Industry.

WE are proud to consider ourselves contributors to your achievements and we thank you for your cooperation in helping us do our part.

TITAN

THE TITAN VALVE and MFG. CO.

Thermostats—Safety Pilots—Relief Valves—Safe ystats

9913 Elk Avenue Cleveland, Ohio

SEMET-SOLVAY PIPING

A steadily growing number of utilities, and process industries are bringing their requirements for plant piping to Semet-Solvay Engineering Corporation.

SEMET-SOLVAY has been specializing in this type of work for many years. Its engineers, shop and field staffs have a background of experience that is the best possible assurance of correct design, economical construction and long service.

Recent large scale contracts successfully executed include systems for the handling of blast furnace, manufactured and natural gases, blast lines and steam and air handling installations.

We invite your inquiries for work of this character, whether requirements are large or small; whether the project represents replacement, modernization or expansion. Our work will be done well—and completed on schedule.

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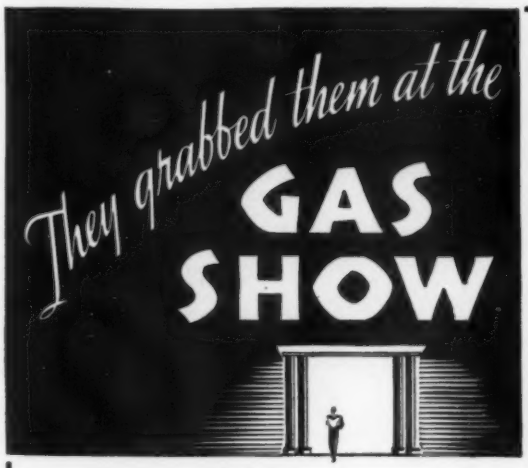

BUT—there are a few remaining copies of this interesting and authoritative review of a test of Gas Purifying Materials . . . and one is yours with the compliments of the makers of LAVINO "ACTIVATED" OXIDE. Write for your copy *today*, before they go!

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Dealer Cooperation

Active cooperation on the part of gas appliance dealers is stimulated by the Empire New York Group through the publication at intervals of their *Dealer Cooperative Merchandising Bulletin.* This Group includes Empire Gas & Electric Co., New York State Electric & Gas Corporation and New York Central Electric Corp., operating in the districts listed in the table below.

Some interesting figures in sales growth are revealed in Spring issue of the *Bulletin* and reflect the results of dealer cooperation coupled with aggressive Company sales activities.

District	Ranges	Refrigerators	Auto. Wtr. Heaters	Tank Wtr. Heaters	Space Heaters	Kitchen Heating	* Gas Heating Jobs in Service
Auburn	454	37	233	43	35	8	644
Cortland	358	82	183	46	62	34	266
Geneva	391	34	161	32	48	6	539
Ithaca	366	47	211	21	43	13	650
Newark	275	60	93	16	43	3	326
Penn Yan	106	30	35	21	28	47	92
Group	1950	290	916	179	259	111	2517
Last Year	1715	178	780	210	243	37	2146

* Note—Gas heating jobs include domestic, commercial, and industrial.

The bulletin also sets quotas for each district for the year 1937.

Major gas appliances sold during 1936 by company and dealers are listed as follows, being the aggregate of both by districts and show comparison with 1935. Substantial gains appear throughout.

The *Bulletin* also sets quotas for each district for the year 1937.

Cooking Carnival

With a total attendance of more than 40,000, The Peoples Gas Light and Coke Company's Cooking Carnival, held in the company's main floor and auditorium February 23 to March 6, turned out to be one of the greatest cooking shows ever staged by the gas industry. It was probably one of the greatest gatherings of food-minded people ever assembled under one roof during a given period, according to present knowledge.

Cooking, baking, broiling, frying, and roasting, all known means of food preparation passed in review over the gas ranges in the various demonstration booths. The carnival proved, in more ways than one, that the best cooking results are obtained by using the modern gas range. Appetizing foods, carefully prepared, convinced the visitors by sight, smell, and taste that they can prepare the menus of experienced chefs—right in their own kitchens.

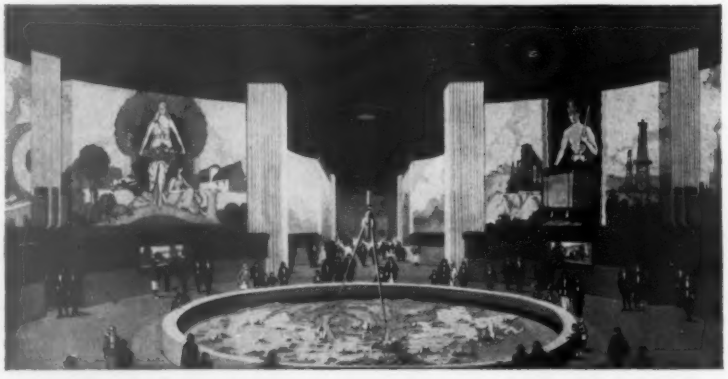
As the visitors to the cooking carnival entered the building, they were presented with a large folder which contained interesting literature on the carnival. This included a booklet on "Controlled Cooking" giving recipes and information on the timing of food cooking; a complete day-by-day and hour-by-hour schedule of carnival events; a folder describing the model kitchens, another folder describing the company's new radio program, and still another folder invited the customers to make use of the Kitchen Planning Bureau when modernizing their homes. Also included in the folder was the Cooking Carnival News, which announced the puzzle contest held in connection with the affair. Five de luxe gas ranges were offered as prizes in the contest. The contest was open to any customer of the company. After the contestants worked the cross-word puzzle, they were required to count the number of times the three-word phrase, "Full Flavor Cooking" appeared in the Carnival News. Space was also provided for the contestants to write 50 words on "How to Get Full Flavor Cooking"—expressing it in their own words.

Exhibit of Gas Fired Hotel Appliances

One of the most successful features of this year's Midwest Hotel Show was the interesting and instructive display of modern commercial gas equipment sponsored by the Industrial Gas Section of the American Gas Association in cooperation with The Peoples Gas Light and Coke Company of Chicago. In all, the Show drew an attendance of 19,352 to the Hotel Sherman, where it was held March 23-26. While a total of 167 exhibitors participated, the gas exhibit was the most attention compelling in view of the great kitchen modernization movement that is sweeping hotels and restaurants from coast to coast. The space of the American Gas Association was filled with the modern gas appliances of several manufacturers.

Many hotel men from all over the country, as well as industrial and commercial gas men and gas company executives, attended and found much to interest them in the equipment of the various participating manufacturers. Of singular appeal to volume hot water users was the exhibit of gas fired plants suitable to supply the particular requirements of this field, where assurance of supply and definite water temperatures are so vitally necessary.

Full advantage was taken of the fact that volume food operators are today more and more leaning toward individuality in their baked goods requirements, to show the latest in gas bake ovens. The idea was put across that any baked products from the daintiest cookie to the fanciest pastry can be produced uniformly day in and day out if the mix is constant, the baking period unchanged and the temperature unvaried. A gas deck bake oven capable of such production was shown and attention drawn to its efficiency and economy of operation.



The colorful rotunda of the "Making of a Nation", one of the features of Cleveland's new 1937 Great Lakes Exposition, which will open on May 29 and continue for 101 days, and the gigantic murals are the work of Juan Larrinaga, celebrated artist. In the foreground is a 150-foot bas-relief of the Great Lakes region. The "Making of a Nation" will occupy 100,000 square feet and will depict the social, agricultural and industrial growth and development of America in working models, dioramas, material displays and murals.

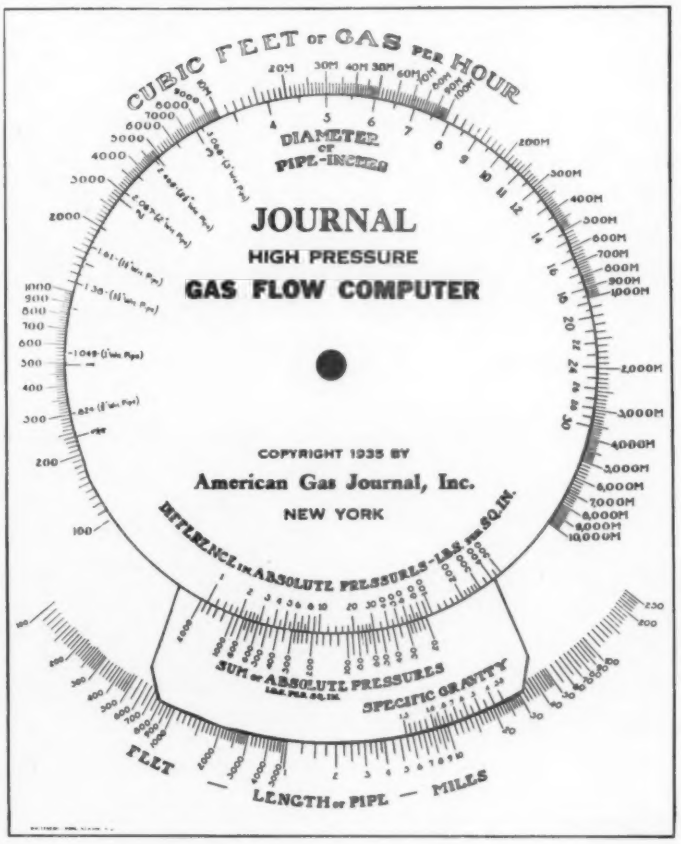
Gas Ranges to be Featured at Great Lakes Exposition

With Cleveland's 1937 Great Lakes Exposition still several weeks away, industrial concerns are already reserving space for the current year. Among those who have made reservations are: The Tappan Stove Company, Mansfield, O.

The 1936 Exposition made the record of selling every foot of available exhibition space, according to Peg Willen Humphrey, associate manager in charge of exhibits. This year's Exposition will be built on the theme "The Making of A Nation" and will give major attention to the accomplishments in the rounds of science, industry and agriculture.

The Exposition, which opens on May 29 and continues for 101 days, will occupy enlarged grounds on Cleveland's lake shore. Scores of new features will make it entirely different from last year's show.

"Journal" Gas Flow Computers



New Improved Gas Flow Computers now available of durable celluloid, encased in a convenient leatherette cover with complete instructions.

Actual Size 6¼ x 7½

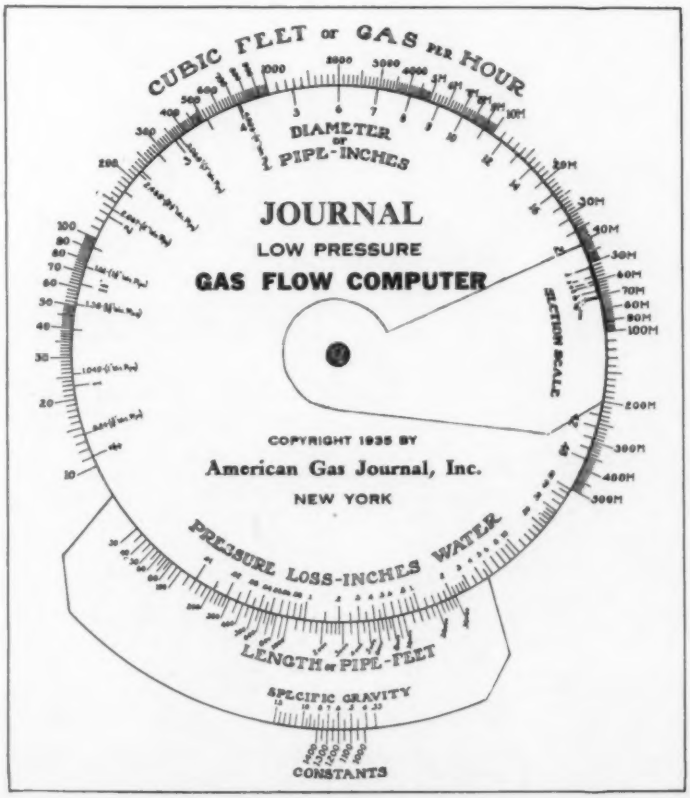
High Pressure Computer Range:

Cu. Ft. of Gas Per Hour—100-10,000 M
Diameter of Pipe Inches ¾-30
Difference in Absolute Pressure—Lbs. per sq. in. 1-500
Sum of Absolute Pressures—Lbs. per sq. in 2000-20
Specific Gravity 1.5-.35
Length of Pipe—Feet 100-5000
Length of Pipe—Miles 1-250

Low Pressure Computer Range:

Cu. Ft. of Gas Per Hour—10 to 500 M
Pipe Diameter ¾" to 48" (including standard and actual weight up to 4")
Pressure Loss Inches .01-10.
Length of Pipe—Feet 30-30,000
Specific Gravity 1.5-.35
Constants 1400-1000

Price $3.50 Each, Postage Prepaid



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Please enter our order for Computers as follows at $3.50 each, postage prepaid

....HIGH Pressure Computer

....LOW Pressure Computer

NAME .....

ADDRESS .....

Coast Counties Gas Holds "Open House"

Between 3000 and 4000 visitors were guests of the Coast Counties Gas and Electric Company at their recent "Open House" held to celebrate the completion of their new district and general office building in Santa Cruz. These visitors passed through the display floor where they had an opportunity to see the latest in modern appliances and were shown through the offices of the company where employes were on hand to explain the various functions of the different departments.

In the general offices, which also include those of the Natural Gas Corporation of California, many saw a billing machine in operation for the first time and became familiar with the general handling of this department.

Visitors were also taken to the basement to view the complete gas heating and ventilating equipment, consisting of two 400 Electrogas furnaces, which filter the air before delivering it into the various offices. For summer ventilation purposes it is possible to operate the blower units with the furnaces off and circulate approximately 18,000 cubic feet of air per minute through the offices.

The latest type Uni-flow directional air supply registers were used throughout, with high side wall mounting. Provision was made to take in about 50% fresh air at all times and recirculate the balance.

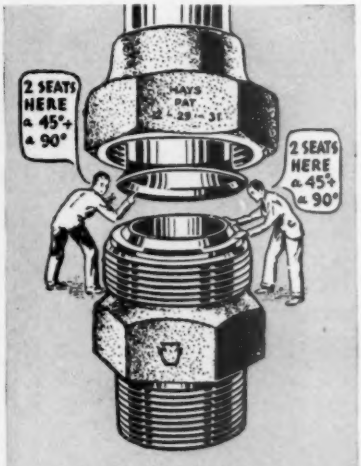
Many of the offices in the building are entirely inside and this complete heating and ventilating system makes it possible for them to be kept at the correct uniform temperature, with plenty of clean, fresh air circulating through the building at all times. Equally careful attention was given to providing various types of lighting in the various offices, with a variety of types of fixtures in use for demonstration purposes.

Designed by Alben Froberg of Oakland, this new building is thoroughly modern both in exterior and interior finish, and while no effort was spared to insure the best type of construction, at the same time no unnecessary trimmings were added to increase the cost without any real benefit to be derived.

"Perhaps the only details which were given more than ordinary places were those of heating and lighting," states President H. L. Farrar of the Company. "Both of these we feel are essential for the well being, health and comfort of our employes. In addition to this, such installations are of dual purpose, as they also furnish a practical working display for the use of local contractors in the demonstration of such equipment to their customers who are interested in similar installations."

Other new buildings recently completed by this organization include a new district office at Los Banos for the Coast Counties Gas and Electric Company and at Avenal for the Natural Gas Corporation of California.

New Building of Coast Counties Gas & Electric Co. at Santa Cruz, California.



Only Double Seals have 2 planes of contact between copper pipe and fitting (45° plus 90°). Use Double Seals wherever strong, air tight, vibration—bend—twist—pull proof connections are desired. Test data to prove the mechanical strength of Double Seals are available.

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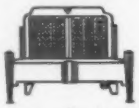

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"A Book like this has long been needed to enable our salesmen to present a sound and convincing attack on this most worthwhile business of our industry."—A. M. Beebee, Gen. Supt. Gas Dept., Rochester G & E Co., Rochester, N. Y.

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Catalogs

About Porcelain Enamel

"Selling Points for Household Appliances," a 24-page booklet containing aids for selling porcelain enameled products, has just been published by the Porcelain Enamel Institute. A feature of the booklet is the center spread which carries the caption, "This Matter of 'Chipping.'" A part of the copy reads: "There is as much substance to this chipping bugaboo for major appliances as there is to the ancient story that a frightened ostrich buries his head in the sand, or that the moon is made of green cheese."

Other pages of the booklet are devoted to reproductions of advertisements of the Institute and selling points on various porcelain enameled products. Free copies may be obtained from the Porcelain Enamel Institute, 612 North Michigan Avenue, Chicago, which maintains an "Educational Bureau" that consists of five sections—technical research, production control, market research, sales promotion and industry contact. Supervising the work of each of these sections are the enameling industry's leaders in each of these fields. With this organization set-up it is the purpose of the "Educational Bureau" to cooperate to the fullest extent with manufacturers, distributors, dealers and salesmen in any way identified with products using porcelain enamel as a finish.

Temperature Control Units

The principles, operating details and methods of application of the Stabilog Potentiometer Control Pyrometer are described in Bulletin 194-1, recently published by The Foxboro Company, Foxboro, Mass. Related equipment for automatic temperature control is also covered.

The bulletin explains how the potentiometric method is effectively combined with the Stabilog air-operated continuous control system. It outlines the unique operating principles in both the measuring and control systems which are said to increase accuracy, prevent "hunting," offset lag conditions and give smooth control by analyzing the rate of temperature change taking place in the process work under control.

There are also specifications and ranges of thermocouples, resistance bulbs and other accessories, thus providng a reference guide for the selection of equipment for continuous temperature control from —300 deg. F. to +2800 deg. F. Copies are available without charge from The Foxboro Company.

C. A. Norgren Co., Inc., Denver, Colo. Catalog No. 200, describing regulating and reducing valves, automatic gas regulators, diaphragm relief valves, industrial blow valves and other automatic products.

Rochester Gas & Electric Year Book

The Year Book issue of Rochester Gas & Electric News gives a well prepared and illustrated résumé of progress made by the Company during 1936. It describes and illustrates the activities of all departments with numerous views of the properties and equipment. Graphs and statistics cover ten years' growth in output, sales and customers served and a map shows the franchise territory covered for both services.

Recent Catalogs and Bulletins

American Schaeffer & Budenberg Division of Consolidated Ashcroft Hancock Co., Bridgeport, Conn., has issued Catalog 200 describing in detail their glass thermometers for industrial uses, including straight and angle form for gas mains with 7, 9 or 12 inch scales, graduated 30 to 180° F.

Davis Regulator Co., 2541 So. Washtenaw Ave., Chicago, has issued a Pressure Regulator Service Chart. A tabular presentation with diagrams of equipment is offered as a guide in choosing the proper type for various services on steam, air, water and gas.

Catalog 900C of C. J. Tagliabue Mfg. Co., Brooklyn, N. Y., describes and illustrates their latest models of Non-Indicating Controllers for temperature, pressure and time with a discussion on how these appliances work. In their Catalog 1100A, laboratory thermometers and hydrometers are shown and listed in detail.

Absolute Pressure Recording Gauges are described in a four page bulletin of The Foxboro Company, Foxboro, Mass. These gauges automatically compensate for changes in barometric pressure so that direct readings of absolute pressure are obtainable on a 12" chart without recourse to mathematical corrections. Special pressure controller and pressure indicating gauges are also briefly described.

Eastman Mfg. Co., Manitowoc, Wis., have issued Catalog 37-G, describing semi-rigid and flexible gas appliance tubing, utility fittings, couplings and connectors Among the items featured is the "Push-O-Matic" gas valve for various gas appliances which requires a thrust as well as a turn to open it and is automatically locked when closed.

The Behaviour of Refractory Materials in the Gas Making Plant, Part 2 of an article by A. T. Green, appears in the March issue of "West's Gas." Copy may be had by writing West Gas Improvement Co., 424 Madison Ave., New York.

Brown Pyrometers

Catalog No. 15C of Brown Instrument Co. of Philadelphia, Pa., illustrates and describes the complete line of Brown Millivoltmeter Pyrometers,—indicating, recording and controlling. Included also is description of the Brown Optimatic Pyrometer and several accessories for high temperature reading and recording. Copy will be sent on request.

As Germans See Us

"The (American) holding companies know full well that the turn-over of capital invested in gas companies is double as fast as in electric companies and assures a very good return at only half the financial risk. The fact that the holding companies see the combined income of their electric as well as their gas properties in a net balance sheet prevents them from making the mistake of letting one kind of energy take away orders from another and thereby cutting their overall income. The holding companies realize that a cheaply stored gas is better suited to cover a big energy demand, cooking for instance, than the very expensive storing of electric current. They check solicitation of new accounts having certain high demands so that they will not have to make new large investments in the future to furnish current with large power losses. Loads developed through low special rates, not true to cost, are not encouraged. Only in a few cities, as for instance Brooklyn, where electric power and gas supply are owned by different concerns, does a picture of unpleasant and destructive competition present itself."—*American Gas Association News Bulletin.*

Plant Lighting Systems

A new 36-page handbook, provides the plant operating executive with a treatise covering the commonly encountered problems of factory lighting and their solution.

Written in plain, non-technical language and profusely illustrated. Gives the answers to scores of lighting problems involved in inspection and production operations found in practically any industrial plant.

Sent to plant executives who request it. Address the Benjamin Electric Mfg. Company, Des Moines, Illinois.

Vigor-Aire Corp., Philadelphia, Pa. A folder describing an air conditioning unit for the home or office. It operates by plugging in a light socket.

Harnischfeger Corp., Milwaukee, Wis. Bulletin W-8, describing a new line of simplified Sootharc welders. Illustrations show types of apparatus and various uses.

Linde Air Products Company, New York, describes an improved welding method used in the construction of over 5,000 miles of cross-country pipe lines in "Lindewelding Pipe Lines," a 32-page (8½ x 11) illustrated booklet.

Features treated are the economy and rapidity of construction, quality and strength of welds and simplicity of field operations. Other subjects covered are the growth of pipe line welding since 1914, time and material records on typical Lindewelded lines, construction organization and methods, welding specifications, welding rod and technique, metallurgical considerations, multi-flame welding, and the all-bell-hole method.

Personals

Personnel Changes at the Testing Laboratories

R. M. Conner, Director of the Testing Laboratories of the American Gas Association, recently announced several changes and advancements in the executive personnel at the Cleveland Laboratories.

Early in February, Dr. F. E. Vandaveer was transferred to Cleveland from Los Angeles to resume his duties as Supervisor of both the Cleveland and Pacific Coast Branch Laboratories directly under Mr. Conner.

W. M. Couzens, a graduate of Tri-State College of Engineering in 1926, was recently placed in charge of all the Labora tories' research activities. Mr. Couzens entered the employ of the Laboratories in the Testing Department in 1926.

K. H. Flint, a graduate of Amherst in 1923 and M. I. T. 1925, has been elevated from Chief Inspector to Assistant Chief Engineer in the Testing Department. Mr. Flint joined the Laboratories in January, 1926.

W. H. Vogan, Tri-State College of Engineering 1927, has been appointed Chief Inspector to fill the vacancy left by the promotion of Mr. Flint. Mr. Vogan has had nine years' experience in the Testing and Research departments of the Laboratories.

Elmer Mattocks Leaves A.G.A. Laboratories

Elmer O. Mattocks recently resigned from the staff of the A. G. A. Testing Laboratories to join the Phillips Petroleum Company as industrial engineer.

As Industrial Engineer at the A. G. A. Testing Laboratories since 1931 Mr. Mattocks has worked on all industrial research problems instituted there by the Committee on Industrial Gas Research. During the past six years Mr. Mattocks' work has greatly contributed to findings as reported in seven bulletins on industrial research published by the Laboratories. He is also credited with much of the development of advanced testing apparatus made necessary by these special investigations.

C. E. Sullivan (Vice President

The Foxboro Company, Foxboro, Mass., makers of industrial precision instruments, have just announced the appointment to Vice Presidency of Mr. C. E. Sullivan, who has been affiliated with the company for 26 years, and has occupied the position of Sales Manager since 1920.

Mr. Sullivan will spend the next six week in Europe visiting the Foxboro fac tory in England and distributors in other European countries.

Bruce B. Wallace has joined the staff of the Los Angeles office of The Foxboro Company, Foxboro, Mass., makers of industrial precision instruments. Mr. Wallace will work out of Los Angeles as a sales engineer.

New Lincoln Appointments

The Lincoln Electric Company, Cleveland, Ohio, announce the appointment of Don McCormick as arc welding consultant for the Kansas City, Missouri, office, at 1818 Main Street.

Mr. McCormick was formerly welding supervisor for the Sheffield Steel Company of Kansas City, and has had broad experience in the practical application of electric welding. His work will be under the supervision of E. D. Anderson, who is in charge of the Kansas City office.

Two appointments to the sales staff of its Philadelphia office are also announced. These include William Sivyer, graduate of the University of Illinois, and B. B. Ross, graduate of Kentucky Wesleyan College.

Mr. Sivyer and Mr. Ross will assist Messrs. O. P. Lang, H. H. Stahl, L. J. Cogan of the Philadelphia office, which is under the management of George R. Johnson.

Air Reduction Sales Changes

Air Reduction Sales Co., Lincoln Bldg., New York, announce the following changes in their sales personnel: H. F. Henriques and J. J. Lincoln, Jr., become assistant general sales managers in Cleveland and Pittsburgh, respectively. J. M. Driscoll is appointed acting manager at Cleveland after eight years' service with the company. S. D. Edsall becomes acting district manager at Pittsburgh, A. W. Brown is appointed assistant railroad sales manager with headquarters in New York, and J. F. Pryor is now located in Houston, becoming vice president of Magnolia Airco Gas Products Co., who handle all Airco activities in Texas.

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General Refractories Elects Officers

At a meeting of the Board of Directors of General Refractories Company, held on April 16, 1937, Mr. S. M. D. Clapper, formerly President, was elected Chairman of the Board, and Mr. Floyd L. Greene, formerly Executive Vice President, was elected President.

Leon C. Hulse Promoted

Frank H. Dewey, general manager of the air conditioning division of Gar Wood Industries, Inc., has named Leon C. Hulse for the position of factory sales engineer of the air conditioning division of the Company. Mr. Hulse, a graduate mechanical and registered civil engineer, has been connected with the air conditioning division for the past six years. His new work includes supervisory engineering duties and participation in general sales activities.

Jared A. Smith Named Niagara-National Distributor

Mr. Jared A. Smith, of Cincinnati, Ohio, announces his appointment as Distributor for Niagara Gas-Fired Furnaces and Winter Air-Conditioning Units, manufactured by The Forest City Foundries Company, of Cleveland, Ohio, and National Gas Boilers, made by The National Radiator Corporation. Mr. Smith's territory will include the states of Kentucky and Ohio, with the exception of the properties of The East Ohio Gas Company.

Mr. Smith is expanding his organization and intends opening offices in several cities in both Kentucky and Ohio to provide localized cooperation for the merchandising of this modern heating equipment. Offices for the organization have been established at 626 Broadway, Cincinnati, Ohio.

Gar Wood Promotes Stanley E. Chase

Frank H. Dewey, general manager of the air conditioning division of Gar Wood Industries, Inc., has announced the appointment of Stanley E. Chase, who for the last four years has been connected with the sales department, as manager of the Company's air conditioning division branch at Rochester, New York. S. T. Smith, former branch manager at Rochester, has been transferred to Boston, where he succeeds E. H. Band as branch manager.

Scheffler-Gross Co., Inc., Drexel Bldg., Philadelphia, Pa., will hereafter represent American Car & Foundry Co. in the Philadelphia territory to handle their line of full area lubricated plug valves. They are equipped with complete engineering facilities for applying these valves in the gas as well as other industries.

Home Service Training Course

An educational training course for home service is to be given at the A.G.A. Testing Laboratory in Cleveland for four days—June 15, 16, 17 and 18. The course is sponsored by the Home Service Committee and has been designed for a dual purpose. First, to offer to students and teachers in Colleges of Home Economics an opportunity to study at first hand the work of home service. This has come as a suggestion from many educators so that girls interested in entering the field of home service could gain at first hand a knowledge of the nature of the work and really receive an apprenticeship training in order for them to be more readily absorbed into the home service departments of gas companies.

Second, the course is open also to home service departments, particularly to those home service people who are rather new and would like this over-all picture to adapt to their own home service jobs. While the course is to be kept basic, and as a result perhaps elementary to experienced home service directors, still they are invited to attend. Sales managers in charge of home service also might find it an advantage to attend such a course.

Detailed programs of this course will be sent to all home service directors in the near future. The program will include a study of actual demonstrations, skits portraying different types of home calls, and practical instruction on the care and operation of gas equipment. The A.G.A. Laboratory offers an interesting setting for this course and a group of exhibits is being arranged to augment the instruction course. Kitchen displays will be in evidence as well as basement arrangements featuring heating and hot water systems. The morning sessions will be held at the Carter Hotel, and the afternoon meetings at the A.G.A. Testing Laboratory, 1032 East 62nd Street, Cleveland. Elizabeth Sweeney, Chairman of the Home Service Committee, will preside at all sessions, and any questions on enrollment can be sent to Jessie McQueen, the Home Service Counsellor at A.G.A. Headquarters, New York City.

Cookery Competition

The word "cook-off" is unusual but it adequately describes the second annual Cookery Competition held in New York City the week of March 29, sponsored by the Women's National Exposition of Arts & Industries. This competition was developed by the Exposition in an effort to create interest in the problems of modern cookery among the homemakers of the nation. Through the cooperation of the Commercial Section of the American Gas Association and the Exposition authorities, *GAS* was selected as the official fuel for this championship contest.

The contest rules had wide circulation through the member companies of the American Gas Association, and a conservative figure was that over 12,000 menus were submitted for judging. The menus were judged on the basis of nutritional balance, appearance, seasoning, flavor and cookery technique, and the best menu submitted from each of six regional divisions won for its contestant an opportunity to come to New York and participate in the final "cook off."

The American Gas Association and the following companies in the Metropolitan New York area provided the two modern gas kitchens used for the cookery competition: Consolidated Edison Co. of New York; The Brooklyn Union Gas Company; Brooklyn Borough Gas Company; Kings County Lighting Company; New York & Richmond Gas Company; and the Long Island Lighting Company; with the International Nickel Company providing the cabinets and sink arrangements, comprising the Whitehead line. The twin kitchens, designed by R. M. Martin, Manager of Display for Consolidated Edison Co., assisted by B. M. Mahoney and Mrs. Virginia Hart, were regarded as the hit of the show. A dark green background effectively set off the white equipment which comprised the very latest models in fully automatic gas ranges and gas refrigerators, with the sinks being provided with plenty of hot water by an automatic gas water heater.

The "cook-offs" were held each of three evenings and the first prize of $500.00 went to Mrs. Helen P. Angell of Columbus, Ohio. The other winners follow in order: Mrs. William J. O'Brien, Center Sandwich, N. H.; Miss Evelyne Mischke, Los Angeles, Calif.; Mrs. G. Lehman, Yonkers, N. Y.; Mrs. R. L. Maxey, Villisca, Iowa; and Mrs. Percy Finks, Arlington, Va.

A popular feature during the week's Exposition was a series of afternoon demonstrations, particularly stressing the sales features of modern gas equipment, presented by home service directors in some of the contributing gas companies. The opportunity for these demonstrations was unexpected until the show started, and it was not possible for all the home service directors to arrange their programs to participate. The Home Service Division of the Consolidated Edison Co., presented demonstrations featuring thrift cookery meals, broiler meals and pastry baking. The demonstrators were Caroline Cecil and Linda Oeder. Elsa Steinberger of the Home Service Division of The Brooklyn Union Co., gave an effective "prospect demonstration" playing up oven meals and the flexible top burners. A cake baking demonstration brought out the evenness of baking on modern gas ranges, demonstrated by Mrs. Marjorie Wardman of the Long Island Lighting Company. Jessie McQueen of the American Gas Association supervised the week's activities in the gas industry booth, and participated as a judge in the competition meals.

Wide newspaper publicity throughout the United States was given to the cookery competition, and a great deal of interest was shown by the visitors to the Women's Exposition. It is estimated that over 100,000 attended the Exposition during the week.

Joins the Mystery Chef Program

Starting with the broadcast of May 4th, The East Ohio Gas Company, Cleveland, Ohio, joins the Mystery Chef radio program, using the facilities of NBC Station WTAM. The extension of the program to Cleveland will be made from Buffalo Station WHEN, and the area served by Cleveland's Station WTAM will reach all customers of The East Ohio Gas Company.

With the addition of The East Ohio Gas Company the Mystery Chef program is now being sponsored by companies having more than 6,000,000 domestic gas meters in active service. This is the largest number of meters participating in the program since it was initiated nearly two years ago.

(Continued from page 50)

the same ability. Under impervious paving these organisms may be particularly important as they can produce gases at a rather rapid rate. A leaky sanitary or storm sewer joint may be designated as the cause of pipe failure whereas these organisms, working when the sewage leakage itself was only of a small directly unharmful quantity, may have been the more direct cause. However, a corrosion surveyor can not go bug hunting but the ideas expressed are worth contemplating when seeking the answer to failures from corrosion.

Artificial Conditions

Common causes of highly localized intense corrosion are man-made structures and artificial changes so frequently found in cities. The main trench offers less resistance to the travel of any excess amounts of water than the original soil due to a decrease in compactness, especially during the years immediately following installation. Backfilling results in a mixture of soils where more than one strata exists above pipe level. Trenches settle and often material such as ashes or other soil more corrosive than the original is used to fill the depression.

The highway sub-surface is used for many other purposes than a single utility which not only materially increases the possible number of causes for more rapid corrosion but also complicates determination of the causes and adds to the difficulty of finding a successful method of combating the destruction. The joints of water mains do not necessarily prevent leakage and therefore complete saturation of the surrounding soil frequently occurs. Other metal structures than the water main may be in the sphere of maximum saturation and be affected. The effect of large water leaks may be to produce complete submersion which may actually decrease the rate of corrosion. Complete submersion may provide an improved ground for the escape of stray currents thus increasing damage or provide a less resistance to the passage of current from one metal structure to another. Although not frequent, particularly damaging results have occurred where corrosion has resulted in the penetration of a water main and the stream of water carrying particles of the intervening soil has gradually worn a hole through gas mains, cables and other structures.

Gas leakage usually increases the acidity of the surrounding soil providing sufficient moisture or liquids are furnished by the gas or soil. Leakage from low pressure systems is apt to be more destructive because of its greater saturation compared with high pressure. High pressure gas when released to or slightly above atmospheric pressure changes its relative humidity and becomes dry resulting in the balls of whitened bone dry soil frequently observed around such leaks. Both the decrease in or exclusion of oxygen, depending on the type of gas served and the dryness around these latter leaks will lessen the rate of corrosion.

The oils released by some leaking gases will accelerate corrosion, similarly to leakage from oil conveying lines. Acceleration of corrosion appears to be independent of the type of oil. A sufficient quantity of oil to produce a visible concentration appears to be necessary to produce rapid corrosion. Exclusion by the oil of a part or all of the atmospheric oxygen may cause a potential difference between points of lesser or no, and normal oxygen concentration. Corrosion will occur where the oil completely excludes oxygen. This latter conclusion has resulted from observations of the

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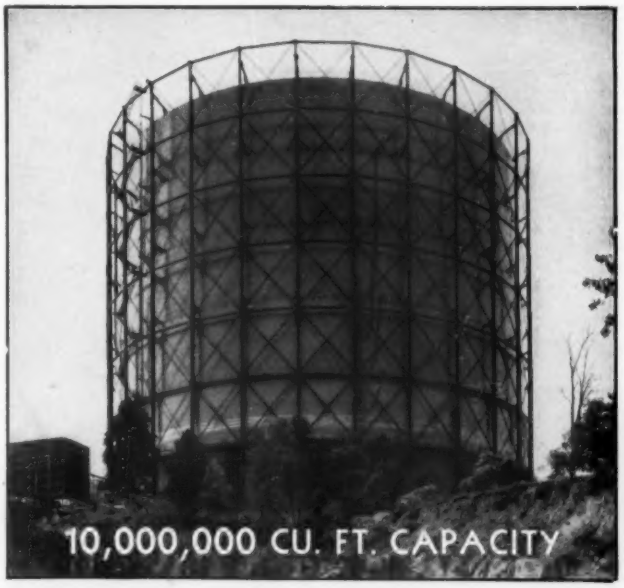

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rapid color changes of the products of corrosion or metal which sometimes occur when exposed to the air. Corrosion in oil bearing soils is usually sharply defined pitting containing a black green or white deposit which is not definitely characteristic of such corrosion as this condition has been observed in acid and salt mash conditions.

Rogers (3) has mentioned instances where oil soaked soils have decreased the life of six-inch diameter 19-pound pipe from 30 to 6 years. The rate of corrosion, he states, appears to increase in proportion to the oil saturation up to complete submersion of the metal. That oil was the cause of increased corrosion rates was proven by replacing mains in oil-soaked soil and backfilling with non-contaminated soil. After 4 to 6 years in the oil-free soil, the corrosion rate became normal. Rogers mentions that even oils with such low total sulphur content as 0.19 to 0.60% have been found to decidedly increase the rate of corrosion. An important factor in mitigating the effects of oil leakage is good drainage and abundant rainfall. The source of oil contaminating a soil may not be a leaking pipe but may be waste from an oil refinery or oil field. In some manufacturing processes waste oil may be dumped onto the ground or a practically uncontrollable oil waste may find its way into the soil. The effect in any case would be practically the same for corresponding concentrations of oil in the soil.

Another leakage causing considerable corrosion trouble is sewage. Improvement in sewage collection is resulting in a decrease of the quantities leaking out through joints. As mentioned the bacteriological action resulting from sewage fermentation may add to the destructiveness of corrosion. Sewage may also act as water in producing a higher average soil saturation or increase soil conductivity. The waste from various industries may be particularly destructive to bare metals and though strict supervision is maintained by most cities of the industrial wastes dumped into sewers, continuous watching is impractical. Leakage from such industrial wastes frequently dissolves or chemically reacts on metals in addition to increasing the rapidity of galvanic cell action. The appearance of this type of corrosion is often decidedly different from that on adjoining sections. Ordinarily sanitary sewer leakage is more destructive than that from storm drains but particularly in industrial sections metal corrosive wastes dumped on the ground surface may find their way into storm drains.

The leakage of liquids or gases from pipes is not the only possible source as material destructive to buried metals may be scrubbed from the atmosphere by rains, be deposited directly on the surface or have their origin in cesspools. The matter disposed of need not be in liquid form as rains will provide the necessary conveyance if the matter is soluble. Some potential sources of excessive corrosion are ash or trash dumps, sites of former and also existing livery stables, decayed vegetable refuse, chemical works, wineries, breweries, dairies, ice cream plants, drug and ice cream stores, tanneries, steel mills, fertilizers, etc. Atmospheric pollution in some cities and large quantities of fumes or dust in the neighborhood of mills may be a factor. Sulphurous fumes and small sulphur particles are commonly emitted in large quantities from some mills leaving a noticeable lack of vegetation or resulting in a stunted growth of trees. Methods have been developed for testing atmospheric pollution which may be advantageously used to analyze the atmosphere if conditions have been altered in such a way as to suggest the

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possibility of an increased rate of corrosion from the pollution. The concentration of chemicals in the air is usually of a low value and the upper soil layers may absorb them for a considerable time thus delaying the commencing of a more rapid rate of corrosion. Time may thus be allowed to provide against the contingency which is usually very rapid following penetration through the soil to the structure of the destructive elements.

All of these factors are mentioned not to complicate the subject by adding to the already numerous sources of corrosion but to avoid the more and more common tendency to attribute all pitting especially on distribution systems to stray current elecrolysis. The comparative ease with which the existence of stray currents may be ascertained suggests its determination as the logical initial step. With stray current electrolysis eliminated, as frequently occurs, the source of the destructive corroding agent becomes a matter of keen observation.

Such artificial changes as installation of improved road surfaces ordinarily would not materially affect the rate of corrosion. As previously mentioned an increase in average soil saturation under impervious surfaces may slightly increase corrosion but such destructive action may be compensated for by the exclusion of liquids, other than water which may cause a rapid failure in localized areas. On the other hand in some types of soils, particularly sands and gravels, the artificial impervious surfaces may divert precipitation into especially created drains thus lessening the average soil saturation. The industrial, commercial and sanitary conditions in adjacent buildings may be sources of elements destructive to buried metals.

However, one of the most destructive of leakages is that of electrical currents, particularly direct current. Both the continuously increasing consumption of electricity and the rapidity of change in its uses adds to the difficulty of tracing the origin of the leakage. The subject is a separate phase of corrosion and will be more fully discussed under Cathodic Protection.

Practical Application of Observations

The part observation may play in a corrosion survey is illustrated by the circumstances leading to examination of a service, which was one of many, found to be almost penetrated due to pitting. On a steep graded street which formerly had only an oiled surface, a 20-foot concrete pavement was installed in the center, leaving the existing main just clear of the concrete edge and approximately six feet from the gutter's edge. The street carried the run off from a large area and therefore had deep gutters. A concrete curb was installed to protect the sidewalk from erosion. The gutter bottom was paved with large stones not cemented or bound together. The gutter construction had left but little cover on the services and therefore the average moisture content was assumed to be high around the service pipe in the gutter area and also the gravelly nature of the soil led to the assumption that oxygen had free access to the pipe. Dairies and horse stables existing up hill from the service further added to the possibilities of damage. The service and main had been installed twenty years previous to the survey but were in good condition when the improved road surface and gutter were constructed. The conditions along the street suggested the possibility of localized severe corrosion.

Resistance measurements were taken and were found to be as follows: 2-3000 ohm cms. in the highly saturated soil at the curb, 5000 in the black gutter soil deposit, 10,000 over the main, 7000 under the concrete, and over 10,000 between the curbing and house.

Measurements of the pH resulted in the following values.

Location	*At Main*	*At Service*	*In Sidewalk*
Elevation below surface			
1 ft.	6.6	7.1	7.8
2 "	7.0	7.6	8.3
3 "	7.6	8.1	
4 "	8.1	8.2	

The main had four feet of cover, the service in the gutter one foot and in the sidewalk two feet. The cast iron main was severely rusted and pit depth measurements were not taken because of the rather heavy uniform loss of metal. The steel service was uniformly rusted and slightly pitted over the whole length except on the two feet of length from the curb facing toward the main where a maximum pit depth of 47 mills was found. Due to the corrosion tests indicating a non-corrosive soil, and because of the uniform rusting of the service it was assumed that the excessive pitting had occurred in the few years between installation of the gutter and the survey. The gutter, previously wider and shallower, had been several feet removed from the new. The deep pitting of the service all occurred in the two feet of length underneath the gutter. A number of services on the same street had the same deterioration. A knowledge of the visible indications of possible severe corrosion simplified the providing of protection before leakage occurred.

This experience has not been confined to services and others have found the same conditions as evidenced by a statement by F. A. Hough, in an article entitled "Pipe Line Protection" in the AMERICAN GAS JOURNAL of August, 1932. The changing of a main location from one side of the street to the other altered the soil corrosion characteristics to such an extent that protection was not necessary for approximately 15,000 feet.

The assumption that services are in more variable soil conditions and therefore the life is less should not be based on external conditions entirely but to the fact that the pipe wall thickness is usually considerably less than that of mains. Services may be partially protected by avoiding filled ground and driveways and locating so that the roof water run-off does not drop directly on the service trench. The adverse experience with artificially created hazards to pipe life indicates the need for knowledge and observation.

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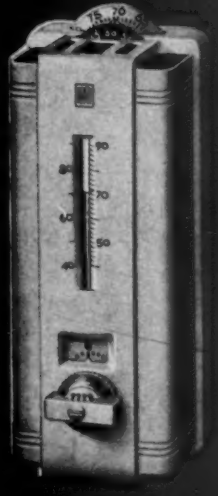

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